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TRANSCRIPT OF RECORD

Supreme Court of the United States

OCTOBER TERM, 1930

No. ~~663~~ 3

THE PERMUTIT COMPANY, PETITIONER,

vs.

GRAVER CORPORATION

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SEVENTH CIRCUIT

PETITION FOR CERTIORARI FILED JANUARY 17, 1931

CERTIORARI GRANTED MARCH 2, 1931

(35,585)

IN THE

Supreme Court of the United States.

OCTOBER TERM, A. D. 1930.

No.

THE PERMUTIT COMPANY,
Petitioner,

vs.

GRAVER CORPORATION,
Respondent.

ON PETITION FOR WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SEVENTH CIRCUIT.

RECORD

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MITFORD C. MASSIE, ESQ.,
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ALLAN C. BAKEWELL, ESQ.,
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Counsel for Respondent.

INDEX.

Index to record of proceedings in the District Court of the United States for the Northern District of Illinois, Eastern Division i

Certificate of clerk 671

Index to record of proceedings in the United States Circuit Court of Appeals for the Seventh Circuit:

Placita 673

Appearance of counsel for appellant, filed June 4, 1930 673

Appearance of counsel for appellee, filed June 6, 1930 674

Appearance of counsel for appellant, filed June 19, 1930 675

Stipulation, filed July 15, 1930, relative to time for filing briefs and requesting case be set down for argument on Oct. 9, 1930 676

Order of July 15, 1930 pursuant to stipulation..... 677

Hearing of Oct. 9, 1930 678

Opinion by Evans, C. J., filed Oct. 20, 1930..... 679

Decree, entered Oct. 20, 1930..... 691

Stipulation to stay mandate, filed Oct. 30, 1930..... 692

Order of Oct. 30, 1930, staying mandate until further order of court 693

Certificate of clerk 695

Order allowing certiorari..... 695

IN THE

United States Circuit Court of Appeals

For the Seventh Circuit

OCTOBER TERM, A. D. 1929.

No. 4390

THE PERMUTIT COMPANY,

Appellant,

vs.

GRAVER CORPORATION,

Appellee.

Counsel for Appellant:

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MR. GEORGE L. WILKINSON,
MR. CHARLES L. BYRON,

Appeal from the District Court of the United States for the Northern District of Illinois, Eastern Division.

INDEX.

PAGE

Placita 1

Bill of Complaint 2

Answer 8

Demand under Equity Rule 58..... 16

Letter, Mar. 18, 1920, The Permutit Co. to Dr. Chas. F. McKenna 17

Stipulation to amend answer, and approval of Judge, filed Aug. 26, 1929 18

Answer to demand 19

Stipulation to amend answer filed Sept. 5, 1929..... 20

Narrative Statement of Evidence.

Plaintiffs' Witnesses:

Hammer, Edwin W. 156, 32

Kriegsheim, Heinrich 173

Mueller, Alfred 184

Paige, Fred O. 156

Tiger, Howard L. 154, 85, 22

Waterman, Frank N. 48

Defendants' Witnesses:

Bachmann, Jacob 147

Eisenhauer, Charles P. 193

Fritze, Lucius A. 190, 148

Morgan, E. H. 189

Moses, Douglas V. 186, 90

Riley, Ray 133

Smith, Russel S. 188

Order approving Statement of Evidence 196

	Introduced in evidence at page	Reproduced at page
Plaintiffs' Exhibits:		
A—U. S. Patent No. 1, 195, 923, R. Gans, Aug. 22, 1916	21	584
B—Volume of exhibits marked as follows:		
No. 1—Stipulation as to certain facts, as to Exhibits, etc.	21	197
No. 2—Defendants' Bulletin dated Feb. 1, 1923	21	199
No. 3—Defendants' Bulletin dated June 1, 1925	21	209
No. 4—Defendants' Bulletin dated Oct. 15, 1927	21	222
No. 5—Defendants' "Model-D" Bulletin.	21	251
No. 6—Blueprint C-243	21	261
No. 7—Blueprint C-242	21	263
No. 8—Blueprint C-240	21	265
No. 9—Defendants' "Model C" Bulletin.	21	267
No. 10—Defendants' Bulletin "Soft Water for Textile Purposes"	21	277
No. 11—Deposition of Sheridan S. Morton	21	279
Deposition of Samuel B. Applebaum.	21	280
Deposition of Arthur E. Howlett....	21	302
No. 12—Photostat, "Typical Precipitation Plant"	21	309
No. 13—Bulletin of Agricultural Station..	21	
No. 14—Photograph of piece of scale....	21	
No. 15—Page from publication "Power"	21	
No. 16—Bulletin of Agricultural Station..	21	
No. 17—Page from publication "Canning Trade"	21	
No. 18—Stipulation of plaintiffs' test of Mar. 27, 1909 and attached blueprints..	21	311
Blueprint ZW-338-A	21	319

	Introduced in evidence at page	Reproduced at page
Blueprint ZW-608	21	321
Blueprint C-1941	21	323
No. 20—Stipulation of plaintiffs' second test of May 15, 1929 and attached exhibits	21	325
Letter, May 15, 1929, Cooper, Kerr & Dunham to Byron	21	328
Letter, May 15, 1929, Byron to Cooper, Kerr & Dunham	21	330
Blueprint G-259	21	331
C—Sketch made by Witness Tiger	28	335
D—Sketch made by Witness Tiger	28	337
E—Sketch made by Witness Tiger	28	339
F—Photograph of paraffine sheet found in bottom of tank in March test (marked for id.)	45	
G—Sketch made by Witness Waterman	59	343
H—Sample of excelsior from excelsior bed (marked for id.)	145	
I—Sketch prepared by Witness Hammer	159	345
J—Deposition of Francis Payne Mason	184	349
Deposition of Adolph Carl Noé	184	358
Deposition of Henry L. Nachman	184	363
Deposition of Felix Stern	184	364
Deposition of Sigmund Waldbott	184	365
Deposition of Alfred O. Lee	184	367
Deposition of George O. Haas	184	371
Deposition of Abram Lipsky	184	381
Deposition of Otto Luthy	184	387
Deposition of Carl V. Bertsche	184	392
Deposition of Alfred Mueller	184	395
Deposition of Dr. Alexander Green	184	408
Deposition of Bernard R. Regan	184	419
Deposition of John W. Scholl	184	431

	Introduced in evidence at page	Reproduced at page
K—Complete parsing by Dr. Scholl (Pltfs.' Ex. 50)	184	437
L—Comparative arrangement (Pltfs.' Ex. 52)	184	444
M—Haas manuscript translation Gans' article (Pltfs.' Ex. 37)	184	445
Excerpts from testimony of Alfred Mueller	184	184
Defendants' Exhibits:		
No. 14—Pail of zeolite	106	
No. 15—Rubber gasket	106	
No. 16—Canvas	106	
No. 17—Can of excelsior	103	
No. 18—Report of Permutit Co. dated Mar. 16, 1927 to Florida Filter Corp.	154	455
No. 19—Rundschau device	106	
No. 20—Stipulation as to certain exhibits, translations, etc	89	457
No. 21—Agreed English translation of German Patent Law	89	
No. 22—Agreed English translation of German Law on protection of Gebrauchsmuster	89	
No. 23—Langner testimony in American Chain Co. case	89	
No. 24—Rundschau article of Jan. 27, 1909	89	461
No. 25—Translation of Exhibit No. 24	89	465
No. 26—Enlargement of drawings in Rundschau article	89	469
No. 27—Article from "The Practical Engineer" June 4, 1909 with Affidavit of Edward T. Kelly	89	471
No. 28—Gebrauchsmuster No. 341,512 (Drawing only reproduced)	89	664
No. 29—Translation of Gebrauchsmuster 341,512	89	665
No. 30—Gebrauchsmuster No. 313,671 (Drawing only reproduced)	89	660

	Introduced in evidence at page	Reproduced at page
No. 31—Translation of Exhibit 30	89	661
No. 32—Feldhoff article of Sept. 7, 1907 (drawing only reproduced)	89	477
No. 33—Translation of Feldhoff article of Sept. 7, 1907	89	479
No. 34—German Patent No. 211,064, to H. Leister Jan. 23, 1908	89	653
No. 35—Translation of Leister patent No. 211,-064, Jan. 23, 1908	89	653
No. 36—Down-flow softener in Permutit vs. Harbey	89	491
No. 37—Down-flow softener in Permutit vs. Wadham	89	493
No. 38—Up-flow softener in Permutit vs. Paige-Jones	89	495
No. 39—Up-flow softener in Permutit vs. Paige-Jones	89	497
No. 40—Defendants' drawing No. ZW-718, of Rundschau water softener	89	499
No. 41—Stipulation re. tests of defendant at Hawthorne Laundry Service on Sept. 12, 1929 and drawing	89	501
No. 42—Stipulation with notice, motion, affidavit of James Q. Rice and disclaimer attached	89	505
No. 43—Stipulation re: testimony of certain witnesses as it appears in transcript of record in Sixth Circuit, case of Permutit vs. Wadham	89	509
No. 44—Deposition mentioned in Ex. 43	89	
No. 45—Stipulation of Oct. 18, 1929 re: certain exhibits, etc.	89	510
Deposition of Alfred Mueller from record in Sixth Circuit	89	511

	Introduced in evidence at page	Reproduced at page
No. 46—Stipulation of Oct. 19, 1929 that Gans article appeared in "Chemische Industrie" on Apr. 15, 1909	89	512
No. 47—Gans article of Apr. 15, 1909 in "Chemische Industrie"	89	513
No. 48—British Patent No. 3870 of 1911 to Wm. E. Evans	89	647
No. 49—U. S. Patent No. 1,276,629, T. R. Duggan, Aug. 20, 1918	89	638
No. 50—U. S. Patent No. 943,535, R. Gans, Dec. 14, 1909	89	631
No. 51—Reissue Patent No. 13,688, R. Gans, Feb. 17, 1914	89	635
No. 52—U. S. Patent No. 478,261, O. H., W. M. & I. H. Jewell, July 5, 1892	89	590
No. 53—U. S. Patent No. 678,532, F. E. Bachman, July 16, 1901	89	614
No. 54—U. S. Patent No 630,870, V. C. Driesbach, Aug. 15, 1899	89	602
No. 55—U. S. Patent No. 632,091, F. Bommarius, Aug. 29, 1899	89	608
No. 56—U. S. Patent No. 707,899, F. Bommarius, Aug. 26, 1902	89	624
No. 57—U. S. Patent No. 519,565, F. Bommarius, May 8, 1894	89	598
No. 58—U. S. Patent No. 960,887, R. Gans, June 7, 1910	89	633
No. 59—Stipulation dated Oct. 25, 1929, re: Weiss thesis	89	521
No. 60—Weiss thesis (drawings only reproduced)	89	524
No. 61—Translation of Weiss thesis	89	525
No. 62—Letter, Mar. 18, 1920, Duggan to Dr. C. F. McKenna	89	546

	Introduced in evidence at page	Reproduced at page
No. 64—Blueprint showing curve referred to by Dr. Moses	95	549
No. 65—Certified copy of Gans File Wrapper and Contents		
No. 66—Blueprint showing exterior of softener at Des Plaines River sewage plant	193	553
No. 67—Model G machine built by Duro Corporation	195	
Memorandum of the Court filed Jan. 20, 1930		555
Decree of Jan. 24, 1930		570
Order extending time for filing record		571
Petition for appeal		572
Assignment of errors		572
Order allowing appeal		574
Bond		574
Stipulation that foregoing is complete record		576
Stipulation re: Exhibits		577
Praecipe for record		577

UNITED STATES LETTERS PATENT.

No. 1,195,923, R. Gans, Aug. 22, 1916	584
No. 478,261, O. H., W. M. & I. H. Jewell, July 5, 1892	590
No. 519,565, F. Bommarius, May 8, 1894	598
No. 630,870, V. C. Driesbach, Aug. 15, 1899	602
No. 632,091, F. Bommarius, Aug. 29, 1899	608
No. 678,532, F. E. Bachman, July 16, 1901	614
No. 707,899, F. Bommarius, Aug. 26, 1902	624
No. 943,535, R. Gans, Dec. 14, 1909	631
No. 960, 887, R. Gans, June 7, 1910	633
No. 13,688, (Reissue) R. Gans, Feb. 17, 1914	635
No. 1,276,629, T. R. Duggan, Aug. 20, 1918	638
British Patent No. 3870 of 1911 to Wm. E. Evans (Defts.' Ex. 48)	647

Translation of German Patent No. 211,064, H. Leister, Jan. 23, 1908 (Defts.' Ex. 35) 653
Drawing of Gebrauchsmuster No. 313,671 (Defts.' Ex. 30) 660
Translation of Gebrauchsmuster No. 313,671 (Defts.' Ex. 31) 661
Drawing of Gebrauchsmuster No. 341,512 (Defts.' Ex. 28) 664
Translation of Gebrauchsmuster No. 341,512, (Defts.' Ex. 29) 665
Certificate of clerk 667
Citation 667
Stipulation regarding printing transcript of record..... 668

1 Pleas in the District Court of the United States for the Northern District of Illinois, Eastern Division, begun and held at the United States Court Room, in the City of Chicago, in said District and Division, before the Honorable Walter C. Lindley, District Judge of the United States for the Northern District of Illinois on twenty-fourth day of January, in the year of our Lord one thousand nine hundred and thirty, being one of the days of the regular December Term of said Court, begun Monday, the 16th day of December, and of our Independence the 154th year.

Present:

Honorable Walter C. Lindley, District Judge.
H. C. W. Laubenheimer, U. S. Marshal.
Charles M. Bates, Clerk.

d
eb. 23, 1928.

2 IN THE DISTRICT COURT OF THE UNITED STATES

Northern District of Illinois

Eastern Division

The Permutit Company,
Plaintiff
vs.
Graver Corporation,
Defendant.
} No. 9709

Be It Remembered, that the above-entitled action was commenced by the filing of the following Bill of Complaint in the above-entitled cause, in the office of the Clerk of the District Court of the United States for the Northern District of Illinois, Eastern Division, on this the 23rd day of February, A. D. 1928, to-wit:

3 * * (Caption) * *

Plaintiff, for its bill of complaint, alleges:

1. That the plaintiff, The Permutit Company, is a corporation organized and existing under the laws of and a citizen of the State of Delaware, and has a place of business in Wilmington, in said State, and that the defendant, Graver Corporation, is a corporation organized and existing under the laws of and is a citizen of the State of Illinois, and has its principal place of business in the City of Chicago, in said State, and in the Northern District of Illinois, Eastern Division, and is a resident and inhabitant of said City and Northern District, Eastern Division.

2. That the jurisdiction of the Court depends upon the patent laws of the United States.

3. That letters patent of the United States, No. 1,195,923, for water softening apparatus, were duly granted on August 22, 1916, to J. D. Riedel Actiengesellschaft, as the assignee of Robert Gans, under and in accordance with the provisions of the then existing Statutes of the United States, as by said patent, or a duly authenticated copy thereof, here in court to be produced, will fully and at large appear; and that

4 the plaintiff, by an assignment in writing dated November 10, 1916, duly recorded in the United States Patent Office, then became and has ever since been and is now the owner of the entire right, title and interest in and to said patent and of

all claims and demands, both at law and in equity, for profits and damages accrued or to accrue because of infringement thereof, as by said assignment, or a duly certified copy thereof, here in court to be produced will fully and at large appear. A printed copy of said Gans patent is annexed hereto as Exhibit A.

4. That letters patent of the United States, No. 1,348,977, for water-softening compound and method of producing same, were duly granted, on August 10, 1920, to George Leonard Borrowman, under and in accordance with the provisions of the then existing Statutes of the United States, as by said patent, or a duly authenticated copy thereof, here in court to be produced, will fully and at large appear; and that by mesne assignments, in writing, duly recorded in the United States Patent Office, the plaintiff, on or about December 16, 1927, became and ever since has been and is now the owner of the entire right, title and interest in and to said patent and of all claims and demands, both at law and in equity, for profits and damages, accrued or to accrue, because of infringement thereof, as by said assignments, or duly certified copies thereof, here in court to be produced, will fully and at large appear. A printed copy of said Borrowman patent is annexed hereto as Exhibit B.

5. That letters patent of the United States, No. 1,455,363, for process of purifying water, were duly granted on May 15, 1923, to the plaintiff, The Permutit Company, as the assignee of Arthur C. Spencer, under and in accordance with the provisions of the then existing Statutes of the United States, as by said patent, or a duly authenticated copy thereof, here in court to be produced, will fully and at large appear, and that plaintiff has been ever since the grant thereof and is now the owner of the entire right, title and interest in and to said patent and of all claims and demands, both at law and in equity, for profits and damages, accrued or to accrue, because of infringement thereof. A printed copy of said Spencer patent is annexed hereto as Exhibit C.

6. That plaintiff has expended large sums of money in making the inventions of said Gans and Spencer patents profitable to itself and useful to the public; that plaintiff and its predecessors in the ownership thereof have expended large sums of money in making the inventions of said Borrowman patent profitable to themselves and useful to the public; that the inventions of said Gans, Borrowman and Spencer patents are and have been of great benefit and advantage to the public; that the public has generally acknowledged and acquiesced

in the rights of the plaintiff and its said predecessors thereunder; and that defendant has had due notice of said letters patent and each of them and of the rights of plaintiff and its predecessors thereunder.

7. That the defendant, by making or causing to be made, and selling or causing to be sold, and using or causing to be used, in the Northern District of Illinois, and elswhere in the United States, water softening apparatus made in accordance with and embodying the inventions and improvements set forth in said Gans letters patent No. 1,195,923, and more particularly the inventions and improvements set forth in claims 1 and 5 thereof, and by making or causing to be made, and selling or causing to be sold, a water softening compound embodying the inventions and improvements described and claimed in said Borrowman patent No. 1,348,977, and by using or causing to be used a process of purifying water embodying the inventions and improvements described and claimed
6 in said Spencer patent No. 1,455,363, has, wilfully and without the consent of the plaintiff, as to said Gans and Spencer patents, and of plaintiff and its predecessors in ownership as to said Borrowman patent, since the respective dates of said letters patent and within six years prior to the filing of this bill of complaint, infringed upon said Gans, Borrowman and Spencer letters patent, and each of them, and is still continuing so to do, and has derived unlawful gains and profits from such infringements, which plaintiff would otherwise have received and enjoyed from and under said Gans and Spencer patents and which plaintiff and its predecessors in the ownership thereof would otherwise have received and enjoyed from and under said Borrowman patent; and that defendant has by its said infringement of said Gans and Spencer patents caused damage to plaintiff, and by its said infringement of said Borrowman patent caused damage to plaintiff and its predecessors in the ownership thereof; and that said damage arising from defendant's infringement of said three letters patent, and each of them, will be irreparable unless defendant be enjoined from further infringement thereof.

8. That plaintiff, on or about the 31st day of July, 1919, brought a suit in the United States District Court for the Western District of New York against Harvey Laundry Company for infringement of said Gans patent 1,195,923; that later the Refinite Company, of Omaha, Nebraska, intervened as and became a party defendant thereto; that after trial on pleadings and proofs, said Court, on or about July 6, 1921, entered an interlocutory decree holding that, as to claims 1

and 5 thereof, said patent was valid and had been in-
7 fringed by the defendants, which decree was duly affirmed by the United States Circuit Court of Appeals for the Second Circuit on an appeal therefrom by said defendants; that on or about August 9, 1927, a final decree to the same effect was duly entered in said suit as to the validity and infringement of said claims 1 and 5 of said Gans patent and also directing judgment in favor of plaintiff and against the defendants for the gains and profits realized by them from their infringements; and that, except for an appeal now pending by the defendant Refinite Company as to the amount of the money judgment therein against it, said decree is now in all respects in full force and effect; as by duly authenticated copies of said interlocutory and final decrees, here in court to be produced, will more fully and at large appear.

9. That plaintiff, on or about the 9th day of October, 1918, brought suit in the United States District Court for the Eastern District of Michigan, against Frank L. Wadhams and others, for infringement of the Gans patent No. 1,195,923 here in suit; that later the Borromite Company of America intervened as and was joined as a party defendant to said suit; that after the trial of said suit said District Court held the patent invalid and thereupon entered a decree dismissing plaintiff's bill of complaint therein; that an appeal was taken by plaintiff to the United States Circuit Court of Appeals for the Sixth Circuit from said decree; that thereafter and after due proceedings therein said Circuit Court of Appeals reversed the said decree and in its mandate duly issued and filed in said District Court directed said Court to enter a decree for plaintiff on claims 1 and 6 of said Gans patent; that thereafter an order was duly entered in said District
8 Court on said Mandate; that thereafter a supplemental bill was filed by plaintiff praying that the Wayne Company of South Bend, Indiana, be joined as a party defendant to said suit; and that thereafter and on or about December 23, 1927, a final decree was entered in said suit in favor of plaintiff and against all of said defendants, including said Wayne Company, holding claim 1 and 5 of said Gans patent valid and to have been infringed by said defendants, which decree is still in full force and effect; as by a duly authenticated copy of said decree, here in court to be produced, will more fully and at large appear.

10. That plaintiff, on or about the 28th day of June, 1923, brought suit in the United States District Court for the Southern District of New York, against Paige & Jones Chemical

Company, Inc., for infringement of said Gans patent here in suit, and immediately thereafter a motion for preliminary injunction against said defendant was made by plaintiff and an order was duly entered thereon granting said motion as to claim 1 of said Gans patent 1,195,923; that no appeal was taken by said defendant from said order; that later another motion for preliminary injunction was made by plaintiff against said defendant as to other types of softeners manufactured and sold by it and an order was duly entered thereon granting said motion as to claim 5 of said Gans patent; that, on appeal from said order by said defendant, the United States Circuit Court of Appeals for the Second Circuit affirmed said order except as to certain of such other softeners which it directed in its mandate should be further considered and disposed of at the trial; that thereafter and on or about February 17, 1928, a final decree was duly entered in said suit in favor of plaintiff and against said defendant
9 holding, as to claims 1 and 5 thereof, that said Gans patent No. 1,195,923 was valid and had been infringed by all of the aforesaid softeners manufactured and sold by said defendant, including those which said Circuit Court of Appeals directed should be further considered and disposed of at the trial and that said decree is now in full force and effect; as by duly authenticated copies of said injunction orders and decree here in court to be produced, will more fully and at large appear.

11. That plaintiff, on or about the 6th day of February, 1928, brought suit in the United States District Court for the Southern District of New York, against Paige & Jones Chemical Company, Inc., for infringement of said Borrowman patent No. 1,348,977, and Spencer patent No. 1,455,363, and that thereafter and on or about February 17, 1928, a decree, on consent, was duly entered therein, with said defendant's consent, sustaining said patents and each of them, finding infringement thereof by said defendant and granting an injunction against further infringement thereof by said defendant.

Wherefore, plaintiff prays for writs of injunction as well provisional as permanent, issuing out of and under the seal of this court, enjoining and restraining the defendant, Graver Corporation, its officers, directors, clerks, attorneys, servants, agents and workmen, from infringing upon said letters patent and each of them; that said defendant account to plaintiff for the profits made by it and the damages sustained by said plaintiff, because of its infringements of said Gans and Spen-

cer patents, No. 1,195,923 and No. 1,455,363, and by plain-
10 tiff and its predecessors in the ownership thereof because of its infringement of said Borrowman patent No. 1,348,-977; that the plaintiff recover the costs and disbursements of this suit; and that plaintiff may have such other and further relief as may appear proper and be agreeable to equity; that said defendant be required to answer this bill of complaint, but not under oath, plaintiff hereby waiving verification of defendant's answer.

THE PERMUTIT COMPANY
by H. KRIEGSHEIM
President.

PHILIP, SAWYER, RICE & KENNEDY,
220 Broadway, New York City,
DYRENFORTH, LEE, CHRITTON & WILES,
Solicitors and of counsel for plaintiff.
Marquette Building, Chicago, Ill.

JAMES C. RICE
GEORGE A. CHRITTON
Of Counsel.

State of New York, }
County of New York. } ss.

H. KRIEGSHEIM, being first duly sworn, deposes and says that he is the President of The Permutit Company, plaintiff above named, that he has read the foregoing bill of complaint subscribed by him on behalf of said Company and knows the contents thereof, and that the same is true of his own knowledge, except as to those matters therein stated to be alleged upon information and belief, and that as to those matters he believes it to be true.

H. KRIEGSHEIM

Subscribed and sworn to before me this 21st day of February, 1922.

ARTHUR E. MARCANTE,
(Seal) *Notary Public.*
New York Co. Clerks No. 47
New York Co. Register's No. 9048
Kings Co. Clerks No. 461
Kings Co. Register's No. 9645
My commission expires Mar. 30, 1929.

11 Exhibits marked: Exhibit A, Exhibit B, and Exhibit C hereto attached, but not copied.

(Endorsed) Filed Feb. 23, 1928. Charles M. Bates, Clerk.

8, 1928. 12 And on, to wit, the 18th day of April, 1928, came the defendant by its attorneys and filed in the Clerk's office of said Court a certain Answer in words and figures following, to wit:

13 • • (Caption) • •

ANSWER.

To the Honorable the Judges of the United States District Court, Northern District of Illinois, Eastern Division:

Now Comes Defendant, and for answer unto the Bill of Complaint says:

1. Defendant denies each and every allegation in the Bill of Complaint contained, except as hereinafter admitted or specifically answered or avoided.

2. Defendant admits that it is a corporation organized under the laws of the State of Illinois, and for the purposes of this suit, has a place of business in the City of Chicago, State of Illinois, but denies that it has committed any acts of infringement in the Northern District of Illinois, or elsewhere.

3. Defendant admits that Letters Patent No. 1,195,923 was issued on August 22, 1916, to J. B. Riedel, Aktiengesellschaft, but denies that Robert Gans was at any time the true, original or first inventor of said alleged improvements, and that said Letters Patent was granted upon proper application, and that said Letters Patent is or was valid; but on the contrary
14 defendant alleges, as hereinafter more particularly stated, that said Letters Patent is wholly invalid; that the mechanism therein described and claimed was not new; that the same had been known, described and used and patented prior to the alleged invention thereof by the said Robert Gans, and was in public use and on sale in this country before Gans' alleged invention thereof, and more than two years prior to the filing of the Gans application for Letters Patent.

4. Defendant is not advised except by the Bill of Complaint whether or not due and proper assignment was made by the said Robert Gans to said J. D. Riedel Aktiengesellschaft, and that proper assignment was made by the latter to plaintiff herein covering the aforesaid Letters Patent, and for profits and damages accrued or to accrue because of infringement thereof, and therefore calls upon plaintiff to make proper proof of same.

5. Defendant admits that Letters Patent No. 1,348,977 was issued August 10, 1920, to George Leonard Borrowman, for Water Softening Compound and Method of Producing Same, but denies that said George Leonard Borrowman was at any time the true, original or first inventor of said alleged improvements, and that said Letters Patent was granted upon proper application, and that said Letters Patent is or was valid; but on the contrary, defendant alleges, as hereinafter more particularly stated, that said Letters Patent is wholly invalid; that the compound and method of producing same therein described and claimed were not new; that the same had been known, described and used and patented prior to the alleged invention thereof by the said George Leonard Borrowman, and was in public use and on sale in this country before Borrowman's alleged invention thereof, and more than two years prior to the filing of the Borrowman application for Letters Patent.

15 6. Defendant is not advised except by the Bill of Complaint whether or not due and proper assignment was made to plaintiff covering the aforesaid Letters Patent, including the rights of recovery of profits and damages accrued or to accrue because of the infringement of said Letters Patent, and therefore calls upon plaintiff to make proper proof of same.

7. Defendant admits that Letters Patent No. 1,455,363 was issued May 15, 1923, to The Permutit Company, for a Process of Purifying Water, but denies that Arthur C. Spencer was at any time the true, original or first inventor of said alleged improvements, and that said Letters Patent was granted upon proper application, and that said Letters Patent is or was valid; but on the contrary, defendant alleges, as hereinafter more particularly stated, that said Letters Patent is wholly invalid; that the process therein described and claimed was not new; that the same had been known, described and used and patented prior to the alleged invention thereof by the said Arthur C. Spencer, and was in public use and on sale in this country before Spencer's alleged invention thereof, and more than two years prior to the filing of the Spencer application for Letters Patent.

8. Defendant is not advised except by the Bill of Complaint whether or not due and proper assignment was made by the said Arthur C. Spencer to plaintiff covering the aforesaid Letters Patent and for profits and damages accrued or to accrue because of infringement thereof, and therefore calls upon plaintiff to make proper proof of same.

9. Defendant denies each and every allegation set forth in Paragraph No. 6 of the Bill of Complaint.

16 10. Answering Paragraph No. 7 of the Bill of Complaint, defendant denies past or present infringement of said Gans, Borrowman and Spencer Letters Patent, and denies each and every other allegation set forth in said paragraph.

11. Defendant is not advised except by the Bill of Complaint, with respect to the suits, mandates, decrees or injunctional orders referred to in Paragraphs Nos. 8, 9, 10 and 11 of the Bill of Complaint, and therefore calls upon plaintiff to make proper proof of the same.

12. The defendant is informed and believes, and therefore avers the fact to be, that said Letters Patent No. 1,195,923, and each of the claims thereof, is invalid and void for the following reasons:

a—Because Robert Gans, the patentee of said Letters Patent No. 1,195,923, was not the first and original inventor of the alleged improvements described and claimed in said Letters Patent, but the same thing, in all material and essential features, was, previous to the alleged invention by said Robert Gans, and more than two years before the date of the application for the said Letters Patent No. 1,195,923, fully described and set forth in the following Letters Patent of the United States and foreign countries and in other publications, as follows:

United States Patents:

W. Jasper No. 47,308 Apr. 18, 1865
F. Bommarius No. 632,091 Aug. 29, 1899
J. J. McTighe No. 391,328 Oct. 16, 1888
G. D. Gerson No. 402,433 Apr. 30, 1889
O. H. & I. H. Jewell No. 418,186 Dec. 31, 1889
O. H. Jewell No. 423,430 Mar. 18, 1890
O. H. Jewell No. 418,335 Dec. 31, 1889
O. H. & W. H. Jewell No. 425,573 Apr. 15, 1890
O. H. Jewell No. 377,389 Feb. 7, 1888
O. H. Jewell No. 377,390 Feb. 7, 1888
O. H. & I. H. Jewell No. 413,671 Oct. 29, 1889
Davis & Riddell No. 450,223 Apr. 14, 1891
T. L. Duggan No. 1,276,629 Aug. 20, 1918

17 C. P. Allen No. 538,720 May 7, 1895
G. B. Heideman No. 547,547 Oct. 8, 1895
O. H. Jewell, et al. No. 478,261 July 5, 1892
J. M. Davidson No. 544,566 Aug. 13, 1895
T. H. Boyer No. 554,858 Feb. 18, 1896

W. M. Deichler No. 613,194 Oct. 25, 1898
V. C. Driesback No. 630,670 Aug. 15, 1899
F. Bommarius No. 707,899 Aug. 26, 1902
F. E. Bachman No. 678,532 July 18, 1901
R. Gans No. 943,535 Dec. 14, 1909
(Reissue) No. 13,688 Feb. 17, 1914
Massaciu & Newman No. 1,202,557 Oct. 24, 1916
(In part continuation of appl'n filed Nov. 18, 1910)
R. Gans No. 960,687 June 7, 1910.

Foreign Patents:
British patent—Wetter No. 26,842 of 1909
British patent—Evans No. 3,870 of 1911
German patent—F. Harm No. 95,447 of June 2, 1896
German patent—Riedel Akt.—Ges. No. 197,111 of Oct. 26, 1906
German patent—H. Leister No. 211,084 of June 24, 1909
German Gebrauchsmuster, J. D. Riedel, Akt. No. 313,671 of June 27, 1907
German Gebrauchsmuster, August Neumann, No. 341,650 of May 15, 1908
German Gebrauchsmuster, August Neumann No. 342,212 of May 19, 1908
German Gebrauchsmuster, August Neumann No. 341,512 of June 15, 1908.

Publications:
Pages 59 to 69, inclusive, of Vol. 3 of "V Internationaler Kongress fur Angewandte Chemie, Berlin, 1903".
Page 1078 of "Chemiker Zeitung, 1903, No. 87."
Pages 691-692 of "Chemiker Zeitung, 1907, No. 55."
Page 246 of "Best Sugar Manufacture & Refining, Ware, 1905."
Pages 367 to 369, inclusive, of "Outlines of Industrial Chemistry—Thorp, 1898."
Pages 1172 and 1173 of "Journal Society Chemical Industry, Dec. 15, 1908."
"Modern Methods of Water Purification," Don & Chrisholm, 1913, second edition, pages 188 to 193, inclusive; pages 254 to 256, inclusive, and page 250.
Centralblatt fur die Zuckerindustrie #49, XV. Jahrg, Magdeburg, 7 September, 1907, pp. 1307-1310.
18 Centralblatt fur die Zuckerindustrie, Magedeburg, 16 November, 1907, No. 7, XVI. Jahr, pp. 172-174 and 373-374.
Poggendorfs Annalen Bd. 105 of 1858, p. 132.

Landwirtschaftl Versuchsatationen, Dresden, Bd. 2, 1859, p. 113 et seq., Dr. E. Peters.

Die Deutsche Zuckerindustrie, Berlin, Apr. 12 and 19, 1901, p. 630.

Landwirtschaftl Versuchsatationen, Berlin, Bd. 55, 1901, p. 149, Dr. A. Rumpler.

Jahrbuch der Kgl. Preuss. Geolog. Landesenstalt und Berga-Kademic feer 1905, Bd. XXVII., Heft 1, Berlin, p. 180-181.

Jahrbuch der Kgl. Preuss. Geolog. Landesanstalt und Berga-Kademic feer 1906, Bd. XXVII., Heft 1, Berlin, p. 79.

Catalog of Permutit Filter Co. G.m.b.H. Berlin N-39. (Exhibit 47 in Buffalo case).

Catalog of Permutit Filter Co. G.m.b.H. advertising the "Aquaril" Filter. (Exhibit 48 in Buffalo case).

Zeitschrift fur Angewandte Chemie und Zentralblatt fur technische Chemie, Heft 2, Leipsig, May 28, 1909, pages 1019 to 1024.

Chemische Industrie, April 15, 1909, Vol. 32, pp. 197 to 199, wherein appears the article "Ueber die technische Bedeutung der Permutite, (der kunstlichen zeolithartigen Verbiundungen)" von Dr. Gans.

Technische Rundschau, supplement of Berliner Tageblatt, January 27 and January 28, 1909, pages 43 and 44, an article entitled "Wasserreinigungs-Verfahren mit Permutit."

Die Saison, for October 1908, No. 241, p. 1025, wherein appears the article "Weichwasser-Filter, Aquariel."

and in many other Letters Patent and printed publications not known to this defendant, but the data concerning which when discovered thereafter, the defendant prays leave of court to furnish and incorporate herein by suitable amendment.

19 b—Because the said alleged invention of the said Robert Gans, in every material and substantial part thereof, was known to and used by and was the completed invention of others in this country prior to the alleged invention thereof by the said Robert Gans, and was in public use and on sale in this country for more than two years prior to the filing of the application for said Letters Patent No. 1,195,923; and the names and residences of the persons who invented or who had prior knowledge of the thing patented, and the places where and the names of the persons by whom it was publicly used and on sale in this country for more than

two years prior to the filing of the application for said Letters Patent are as follows:

Name Residence Place of Public Use & Sale

Omar H. Jewell—Chicago, Illinois—Chicago, Illinois

O. H. Jewell Filter Co.—Chicago, Ill.—Chicago, Illinois

Charles P. Allen—Denver, Colorado—Denver, Colorado and elsewhere

Chester B. Davis, Edward H. Riddell—Chicago, Illinois—Chicago, Illinois and elsewhere

University Hospital—Kansas City, Mo.—Kansas City, Mo. since 1902

Samuel Hird & Sons—Passaic, New Jersey—Passaic, New Jersey.

13. The defendant is informed and believes, and therefore avers the fact to be, that Letters Patent No. 1,348,977, issued August 10, 1920, to George Leonard Borrowman, and each of the claims thereof, is invalid and void for the following reasons:

a—Because George Leonard Borrowman, the patentee of said Letters Patent No. 1,348,977, was not the first and original inventor of the alleged improvements described and claimed in said Letters Patent, but the same thing, in all material and essential features, was, previous to the alleged invention by said George Leonard Borrowman, and more than two years before the date of the application for the said Letters Patent No. 1,348,977, fully described and set forth in the following Letters Patent of the United States and foreign countries and in other publications as follows:

Geo. H. Widner No. 1,207,896 Dec. 12, 1916

Robert Gans No. 951,641 Mar. 8, 1910

Robert Gans No. 914,403 Mar. 9, 1909.

Valerius Kobalt No. 1,147,515 July 20, 1915

Robert Gans No. 1,121,490 Dec. 15, 1914

Robert Gans No. 943,535 Dec. 14, 1909

Robert Gans (Reissue) No. 13,688 Feb. 17, 1914,

and in many other Letters Patent and printed publications not known to this defendant, but the data concerning which when discovered thereafter, the defendant prays leave of court to furnish and incorporate herein by suitable amendment.

b—Because the said alleged invention of the said George Leonard Borrowman, in every material and substantial part thereof, was known to and used by and was the completed invention of others in this country prior to the alleged invention thereof by the said George Leonard Borrowman,

and was in public use and on sale in this country for more than two years prior to the filing of the application for said Letters Patent No. 1,195,923; and the names and residences of the persons who invented or who had prior knowledge of the thing patented, and the places where and the names of the persons by whom it was publicly used and on sale in this country for more than two years prior to the filing of the application for said Letters Patent are as follows:

Name	Residence	Place of Public Use & Sale
Geo. H. Widner	DesMoines, Iowa	DesMoines, Iowa
Valerius Kobelt	Berlin, Germany	

21 14. The defendant is informed and believes, and therefore avers the fact to be, that Letters Patent No. 1,455,363, issued May 15, 1923, to Arthur C. Spencer, and each of the claims thereof, is invalid and void for the following reasons:

a—Because Arthur C. Spencer, the patentee of said Letters Patent No. 1,455,363, was not the first and original inventor of the alleged improvements described and claimed in said Letters Patent, but the same thing, in all material and essential features, was, previous to the alleged invention by said Arthur C. Spencer, and more than two years before the date of the application for the said Letters Patent No. 1,455,383, fully described and set forth in the following Letters Patent of the United States and foreign countries and in other publications as follows:

Cornelius Massaciu No. 1,202,557 Oct. 24, 1916.
Ferdinand Blumental No. 1,212,007 Jan. 9, 1917
Adalbert Kolb No. 1,193,794 Aug. 8, 1916.
Adalbert Kolb No. 1,193,795 Aug. 8, 1916.
Permutit Filter Co. Br. 26,094 of 1910.
Deutsche-Filtercompagne Br. 3,057 of 1912.
Pages 683-684 of Dana's System of Mineralogy, 6th Edition, John Wiley & Sons, New York.
Page 200, "Agriculture in Some of Its Relations With Chemistry", by Storer, 4th Edition, 1892, Vol. 1, Chapter VIII.
Encyclopedia Britannia, 11th Edition.

and in many other Letters Patent and printed publications not known to this defendant, but the data concerning which when discovered thereafter, the defendant prays leave of court to furnish and incorporate herein by suitable amendment.

22 b—Because the said alleged invention of the said Arthur C. Spencer, in every material and substantial part thereof, was known to and used by and was the completed invention of others in this country prior to the alleged invention thereof by the said Arthur C. Spencer, and was in public use and on sale in this country for more than two years prior to the filing of the application for said Letters Patent No. 1,455,363; and the names and residences of the persons who invented or who had prior knowledge of the thing patented, and the places where and the names of the persons by whom it was publicly used and on sale in this country for more than two years prior to the filing of the application for said Letters Patent are as follows:

Name	Residence	Place of Public Use & Sale
Ferdinand Blumental	Cologne-Brannsfeld, Germany	

c—Because the said inventions purported to be covered by said Letters Patent Nos. 1,195,923, 1,348,977 and 1,455,383, and particularly set forth in the claims thereof, are devoid of substantial novelty in view of the well-known state of the art, and in each case does not constitute patentable subject-matter or invention or discovery within the meaning of the statute.

d—Because said Letters Patent Nos. 1,195,923, 1,348,977 and 1,455,363, set forth and describe old and familiar means of common knowledge and in common use long prior to the alleged invention thereof by said respective patentees, Robert Gans, George Leonard Borrowman and Arthur C. Spencer, and that said alleged improvements required for their production only the exercise of ordinary skill and knowledge of those skilled in the art to which said inventions belong, and in analogous arts, and that the details of construction and
23 the steps in the processes and methods required nothing more than the merest mechanical skill commonly employed in the work where such alleged inventions might be utilized.

15. The defendant further avers, upon information and belief, that the claims of said Letters Patent Nos. 1,195,923, 1,348,977 and 1,455,363 are so limited and restricted by the prior art, as well as by the acts of said respective inventors and their duly authorized attorneys in prosecuting the applications for said Letters Patent, and particularly by the limitations and restrictions made therein under the requirements of the Commissioner of Patents during the proceedings in the Patent Office while said applications were pending there-

in, as to exclude therefrom any constructions sold by the defendant, and said Letters Patent are thereby limited and restricted to the particular construction, arrangement and description of parts, and processes and methods shown and described in said Letters Patent, and the plaintiff is therefore estopped from obtaining a broader construction of said claims, such as would include any structure made or sold by defendant or any processes or methods used by defendant.

16. Defendant denies that it has done any act or thing or is doing any act or thing, or proposes to do any act or thing in violation of any alleged rights, exclusive or otherwise, belonging to plaintiff or secured by it by said Letters Patent Nos. 1,195,923, 1,348,977 and 1,455,363, or that the plaintiff is entitled to an injunction or any other relief whatsoever.

24 Wherefore, the defendant prays—

That the Bill of Complaint be dismissed and the reasonable costs and charges incurred by the defendant be taxed against the plaintiff; and

That the defendant may have such other and further relief as the circumstances may require.

GRAVER CORPORATION
By WILKINSON, HUXLEY, BYRON & KNIGHT
Solicitors for Defendant.

CHAS. L. BYRON
Of Counsel.
April 11, 1928.

(Endorsed) Filed Apr. 18, 1928. Charles M. Bates Clerk.

. 26, 1930.

25 And on, to wit, the 26th day of August, A. D. 1929, came the Defendant by its attorneys and filed in the Clerk's office of said Court a certain Demand Under Equity Rule 58 in words and figures following, to wit:

26 • • (Caption) • •

DEMAND UNDER EQUITY RULE 58.

Messrs. Cooper, Kerr & Dunham,
Counsel for Plaintiff,
42 Broadway,
New York, N. Y.
Gentlemen:

Pursuant to Equity Rule No. 58, demand is hereby made

by defendant upon plaintiff to admit, in writing, the execution or genuineness of a letter dated March 18, 1920, and addressed to Dr. Chas. F. McKenna, 50 Church Street, New York, N. Y., and written by or on behalf of plaintiff, and signed by Thomas R. Duggan as technical manager of the plaintiff corporation, a copy of which letter is hereto attached.

Respectfully,
WILKINSON, HUXLEY, BYRON & KNIGHT
Counsel for Defendant.

Chicago, Illinois.
August 23, 1929.

Service of the above Demand Under Rule 58 is hereby acknowledged this 23d day of August, 1929, by and on behalf of plaintiff.

GEORGE A. CHRITTON
Solicitor for Plaintiff.

27

The Permutit Company
440 Fourth Ave.
New York

March 18th, 1920.

Dr. Chas. F. McKenna,
50 Church Street,
New York, N. Y.

Dear Doctor McKenna:—

When talking with you over the phone a few days since, I promised to send you some of the literature of this Company so that you might be acquainted with what we do.

We really are what you could call "Water Doctors", and if anyone having any trouble with their water will kindly send us a sample and particulars of the trouble they have, we will undertake to cure it by some method or another, mostly the "Permutit" Process but we do not confine ourselves to that. We always hold ourselves open to any process which might meet the particular case in hand, as there are cases, though very few, in which the "Permutit" process may not be suitable. When we have a case of this kind we do not hesitate to suggest other kinds of processes, but we have yet to find one which can not be treated by the "Permutit" process. There might be commercial reasons why it would not go in but they are few and far between.

The process is a very simple one as you will notice by the literatures which we enclose. It is nothing more or less than a filter but the bed, instead of being sand or some other mate-

rial, is a zeolite which is manufactured in our factory in Brooklyn. Through this water passes, and in passing the mineral constituents Calcium and Magnesium are exchanged for the corresponding Sodium salts so that all hardening materials are taken from the water, leaving a water of absolutely zero hardness which, as you know, is impossible to be obtained by any of the older processes in existence—not even hot lime soda will do it although that is not a bad process. The apparatus is simpler than any other and requires less attention, being practically foolproof.

Should you at any time come across any clients looking for a process which will take up less room than the larger
28 methods require, we shall always be pleased to discuss matters with you and either work through you as the consulting man or take up the matter directly with any client you may introduce to us.

We have now several thousand plants in operation, varying from 500 gallons per day water treated to as many as 3,000,000 gallons per day, without considering Government plants and the like. You will notice in a Government bulletin which we are sending you that the process is on record as being worth consideration and we have several other interesting pamphlets which you will no doubt cast your eyes over and give us the benefit of your wide connection should occasion arise.

Thanking you for your kind consideration, we are

Yours very truly,

THE PERMUTIT COMPANY

THOS. R. DUGGAN,

Technical Manager.

TRD:MK

Enclosures

(Endorsed) Filed Aug. 26-1929 Charles M. Bates, Clerk.

29 And on, to wit, the 26th day of August, 1929, came the parties by their attorneys and filed in the Clerk's office of said Court a certain Stipulation in words and figures following, to wit:

30 * * (Caption) * *

STIPULATION.

It Is Hereby Stipulated, by and between the parties hereto, that defendant may amend its Answer as follows:

By adding to paragraph (a), page 4, line 6, after "and" the word —/or—

By adding to the list of publications on pages 5 and 6 of the Answer, the following:

Pages 721 and 722 of "The Practical Engineer", June 4, 1909.

Das Mangan im Grundwasser und seine Beseitigung, Dissertation zur Erlangung der akademischen Würde eines Doktor-Ingenieurs, eingereicht am 8. Juni 1909, von Weiss, Stadtbaumeister in Glogau, Mündliche Präfung am 27. April 1910.

GEORGE A. CHRITTON
Solicitor for Plaintiff
WILKINSON, HUXLEY, BYRON & KNIGHT
Counsel for Defendant.

Chicago, Illinois
August 23, 1929.
Approved
WALTER C. LINDLEY
United States District Judge.

(Endorsed) Filed Aug. 26, 1929 Charles M. Bates Clerk

31 And on, to wit, the 31st day of August, A. D. 1929, came the plaintiff by its attorneys and filed in the Clerk's office of said Court a certain Answer to Demand in words and figures following, to wit: Filed Aug. 31, 1

32 * * (Caption.) * *

ANSWER TO DEMAND.

Filed Aug 31, 1929.
Messrs. Wilkinson, Huxley, Byron & Knight
Solicitors for Defendant,
First National Bank Building,
Chicago, Ill.

Sirs:

Plaintiff, pursuant to Equity Rule 58 and without waiver of exceptions and objections, admits the letter dated March 18, 1920 addressed to Dr. Chas. F. McKenna, 50 Church Street, New York, N. Y., a copy of which is annexed to demand of defendant dated August 23, 1929, was written on be-

half of plaintiff and signed by Thomas R. Duggan as its technical manager.

Respectfully,
DYRENFORTH, LEE, CHRITTON & WILES,
Solicitors for Plaintiff.

August 29th 1929.
Service of the foregoing answer to demand and the receipt of a copy thereof admitted this 29th day of August 1929.

WILKINSON, HUXLEY, BYRON & KNIGHT,
Solicitors for Defendant.

(Endorsed) Filed Aug. 31-1929 Charles M. Bates Clerk

5, 1929. 33 And on, to wit, the 5th day of September, A. D. 1929, came the parties hereto by their attorneys and filed in the Clerk's office of said Court a certain Stipulation in words and figures following, to wit:

34 • • (Caption.) • •

STIPULATION

It Is Hereby Stipulated, by and between the parties hereto, that defendant may amend its Answer as follows:
By adding to the list of publications on pages 5 and 6 of the Answer, the following:
Chemische Industrie, Vol. 32, No. 8 (632), pp. 197-200, April 15, 1909, On the Technical Significance of the Permutits (Artificial Zeolitic Compounds), by Dr. R. Gans, Director of the Geonomic Laboratory of the Königl Geologische Landesanstalt in Berlin.

DYRENFORTH, LEE, CHRITTON & WILES,
Solicitors for Plaintiff.
WILKINSON, HUXLEY, BYRON & KNIGHT,
Counsel for Defendant.

Chicago, Illinois
September 4th, 1929
Approved:

.....
United States District Judge

(Endorsed) Filed Sept 5-1929 Charles M. Bates Clerk.

35 (Endorsed) • • (Caption.) • • Stipulation.

36 And on to-wit: the 8th day of May, A. D. 1930, there was filed in the Clerk's office of said court a certain Narrative Statement of Testimony, in words and figures following, to-wit: Filed May 8.

37 * * (Caption.) * *

NARRATIVE STATEMENT OF TESTIMONY

Be it remembered that on the trial of the above entitled case in the District Court of the United States for the Northern District of Illinois, Eastern Division, before Honorable Walter C. Lindley, Judge of said Court, the following proceedings were had, to wit:

Trial commenced October 29, 1929.

PLAINTIFF'S PRIMA FACIE TESTIMONY

Plaintiff offered in evidence a copy of the Gans patent in suit No. 1,195,923, said patent being marked plaintiff's Exhibit A.

38 Plaintiff offered in evidence certain stipulations and exhibits bound in a single volume, said volume being marked plaintiff's Exhibit B and contains the following:—

1. Stipulation dated March 30, 1929.
2. Defendant's bulletin dated February 1, 1923. (Pl. Ex. 10 on Preliminary Injunction.)
3. Defendant's bulletin dated June 1, 1925. (Pl. Ex. 11 on Preliminary Injunction.)
4. Defendant's bulletin dated October 15, 1927. (Pl. Ex. 12 on Preliminary Injunction.
5. Defendant's Model "D" bulletin. (Pl. Ex. 13 on Preliminary Injunction.)
6. Blueprint No. C-243. (Pl. Ex. 14 on Preliminary Injunction.)
7. Blueprint No. C-242. (Pl. Ex. 15 on Preliminary Injunction.)
8. Blueprint No. C-240. (Pl. Ex. 16 on Preliminary Injunction.)
9. Defendant's Model "C" bulletin. (Pl. Ex. 30 on Preliminary Injunction.)
10. Defendant's bulletin "Soft Water for Textile Purposes." (Pl. Ex. 31 on Preliminary Injunction.)
11. Depositions of Morton, Applebaum and Howard.

12. Exhibit 4 referred to in depositions.
13. Exhibit 5 referred to in depositions.
14. Exhibit 7 referred to in depositions.
15. Exhibit 8 referred to in depositions.
16. Exhibit 9 referred to in depositions.
17. Exhibit 10 referred to in depositions.
18. Exhibit 12 referred to in depositions.
19. Stipulation of Plaintiff's test of March 27, 1909 and attached blueprints:
Blueprint ZW-338-A
Blueprint ZW-608
Blueprint C-1941
20. Stipulation of Plaintiff's second test of May 15, 192[illegible] and attached exhibits.
Letter—Cooper, Kerr & Dunham to Mr. Byron.
Letter—Mr. Byron to Cooper, Kerr & Dunham.
Blueprint G-259.

39 HOWARD L. TIGER, being first duly sworn on behalf of plaintiff, testified as follows:

Direct Examination by Mr. Cooper.

My name is Howard L. Tiger, I live at 240 West 98th Street, New York City. I am an engineer with the Permutit Company, plaintiff here. I have been connected with it almost eleven years. I was technically educated; I took an engineering course at New York University, obtained my Bachelor's Degree in 1918 and Engineer's Degree the following year. I was in the employ of some other companies for a short period following my graduation, but for about eleven years with the plaintiff. I am Assistant Technical Manager with the plaintiff. I have to do with its output and the quantity of its output; where the devices are put into use and what purposes they serve.

At counsel's request I have taken from the books of the plaintiff, figures which show the output for years beginning with the year 1919.

Mr. Cooper: I may explain to your Honor that in the stipulated testimony the plaintiff's business up to a part of 1919 is included in the papers in Exhibit B and I am simply carrying it on from that point.

40 Q. Will you give the figures that represent the plaintiff's output of these water softeners and the zeolites that go with them and the appurtenant apparatus?

Mr. Byron: Your Honor, of course, this is entirely immaterial and impertinent, and I see no reason why it should go in. I have no great objection, but it is simply immaterial.

The Court: I suppose the purpose is to show the commercial success. I don't know as it is very material, but he may answer.

The Witness: (Continuing) During the year 1919 the Company's turn-over amounted to approximately $800,000. During successive years it increased until in the year 1928 the Company's turn-over amounted to approximately $2,500,000. During the same year 1928 the business of the Company's licensees amounted to about six or seven hundred thousand dollars, making a total of something over $3,000,000 for the year 1928. During 1929 the rate of output has been approximately the same as 1928.

When I spoke of turn-over I meant output, that is, the sales.

In the textile industry these water softeners have had a very marked effect. Whereas in previous years the textile manufacturer was limited in his location by the need for an abundant supply of soft water, the advent and development of the zeolite water softeners has made him practically independent of the hardness of the water. He is now, therefore, free to choose his location for other reasons because he now knows that he can be assured of an absolutely soft water supply by the use of the zeolite softener.

41

We can see an example of this development in the rayon industry, which is a comparatively new industry. We can find rayon factories located in various parts of the country, where the water is hard, as, for instance, the big Dupont factories at Boffalo, where the water is hard, as the water is at Chicago, the Great Lakes, and we can find rayon companies in Pennsylvania in hard water districts, in contradistinction to the location of the other textile industries which previously sought natural soft water locations and therefore concentrated in such districts as New England and the south.

The plaintiff's business in household softeners amounted to approximately 300 to 500 thousand dollars per annum, and the business of its licensees for household softeners in the year 1928 amounted to approximately $400,000 per annum, at that rate.

I would say about $150 to $200 per unit would be an average figure to represent the individual selling price of the plaintiff's water softeners of the size for domestic use. And

as to its licensees, their average is probably a liittle lower. I would say about $100 a unit.

42 I am familiar with the defendant's water softeners here which have been conveniently identified as to construction by the defendant as its 1923 kind, being a down-flow softener and then its 1925 down-flow softener and thirdly its 1927 up-flow softener. I am the author of the three diagrammatic drawings illustrating the flow under various conditions in the defendant's 1923, 1925 and 1927 softeners.

Taking those three drawings which were known on the preliminary injunction motion as Plaintiff's Exhibits 14, 15 and 16, and which are included in the Exhibit B in the trial, I will explain first the conditions of flow in the defendant's down-flow softener of 1923, represented by the diagram Exhibit 14 on the injunction motion.

Starting with normal operation, which is labeled, "Softening" in the upper left hand figure, in this figure the course of flow is as follows: the hard water enters through the pipe 6, passes upwardly through the pipe 7, out of the end of the pipe 9, which terminates inside the softener near the top. The water then passes downwardly through the zeolite bed into the collector system marked 4, out through the pipe 10 and 11, through the meter 30 to service.

43 When the softener has softened its capacity of water it requires back-washing. That is described in Fig. 2 on the drawing. The course of flow is as follows: the hard water enters through the inlet pipe 6, passing through pipes 12 and 10 into the softener and then out of the distribution system at the bottom of the softener, upwardly through the gravel supporting layers and the zeolite bed and out at the top of the softener through pipes 9, 8 and 13 to waste. During this operation—it is called back-washing because it is the reverse direction of flow to what we had in the preceding operation. Its effect, if carried out at the proper rate, is to remove from the zeolite the suspended matter or dirt and slime which has accumulated on the surface of that bed during the softening of the water.

The proper rate of back-washing a softener is one that causes the zeolite bed to obtain a semi-suspended condition so that the granules of zeolite can rub against each other and the dirt can be loosened from the zeolites and carried off by the stream of water, into the sewer.

In the third condition shown on the Sub-Fig. 3 on this same exhibit, the zeolite bed is now ready to be regenerated

or revivified by the salt solution and in Fig. 3 this is accomplished by opening the valve in the brine inlet line, that is, the line connecting the brine preparation tank with the
44 softener itself. This permits the brine to enter through the distribution system 15 whence it passes downwardly through the zeolite bed, out through the collector manifold at the bottom of the softener and out through pipe 16 to waste.

The next operation is to rinse out of the softener the brine which is still contained in there, and that is carried out in the operation of regenerating or rinsing. In this operation the hard water enters through the pipe 6, 7 and 8 and passes into the softener through the pipe 9, and then downwardly through the zeolite bed and down to the bottom of the softener, out through the manifold 4—the manifold means the collecting pipe—out through the manifold 4 and the pipe 16 to waste. This operation is carried out until the water coming out of the softener is soft and the softener is now ready to be placed in operation again for softening.

I will take up the defendant's other softening apparatus put out in the year 1925 as the various operations are illustrated on the drawing, which is plaintiff's exhibit 15. This is also a down-flow softener, that is, the water is softened by passing downwardly through the bed of zeolite. In Fig. 1 in the upper lefthand corner the softening operation is illustrated. In this operation the hard water enters through the pipe 6, 7, 8, enters the softener through the pipe 9 and
45 then passes downwardly through the zeolite bed, down to the bottom of the softener through the notched ring 21, out of the pipe 10 to service. When the softener has softened all the water it can, the bed is back-washed. That operation is illustrated in Fig. 2. In this operation the hard water enters pipe 6, passes through pipe 12, 11, 10, down to the bottom of the softener, out through the openings in the notched collar 21, upwardly through the supporting screen 20, and then through the gravel supporting layer and then through the zeolite bed, out of the pipe 9, 8, 16, 17, to waste.

When the bed has been properly back-washed the softener is ready for regeneration. That operation is illustrated in Fig. 3 at the lower left hand. In this operation the brine is introduced into the softener from the brine tank by means of a water ejector; it happens in this case, passes in through pipe 22, 8, 9, downwardly through the zeolite bed, down to the bottom of the softener through the supporting plate,

through the notches in the collar, out through pipe 10, 18, 17, to waste.

After the requisite amount of brine has been passed into the softener, it is necessary to rinse the softener free from salt. That operation is illustrated in Fig 4. In this operation the hard water enters through pipe 6, 7, 8, 9, passes in at the top of the softener, downwardly through the zeolite bed to the supporting gravel layer, then through the perforated screen 20 and then down to the bottom of the softener through the notches in the ring collar 21 and then out-
46 wardly through the pipe 10, 18, 17, to waste. This operation is carried on until the effluent of the softener is soft and the unit is now ready to be placed in service again.

In like manner I will take up the defendant's up-flow softener of 1927 in connection with the drawing made and which was known as Plaintiff's Exhibit 16 on the preliminary injunction motion. This is an illustration of an up-flow softener, that is, the water during the softening operation passes upwardly through the zeolite bed. The normal operation of softening is illustrated in Fig. 1 in the upper lefthand corner. In this operation the hard water enters through the meter at 30, the pipe 11, the pipe 10, passes down to the bottom of the softener, then upwardly through the supporting screen plate 20, then through the gravel layers 3, then upwardly through the zeolite bed 2 and out at the top of the softener through pipe 9, 8, 7 and 6 to service.

When the softener has softened all the water for which its capacity is rated, it requires regeneration. This operation is illustrated in Fig. 2. In that figure the brine is passed into the softener by means of an injector through pipe line 22, then through the end of pipe 9 into the top of the softener, then downward through the zeolite bed, through the gravel layer to the supporting screen 20, down to the bottom of the softener and through the notches in the collar, out through pipe 10, 18 and 17 to waste.

47 When the requisite amount of brine has been introduced the softener requires rinsing or washing, as illustrated in Fig. 3 of the drawing. In this operation the hard water enters through the meter and pipe line 11, 7, 8, 9, passes in at the top of the softener, downward through the zeolite bed, down through the gravel layers, through the supporting screen 20 to the bottom of the softener, through the notches in the ring collar 21 at the bottom, upwardly through pipe 10, 18, 17, to waste. When that operation is completed it is necessary to displace from the softener the hard water

which is lying above the zeolite bed, that hard water having been introduced during the previous rinsing operation. To accomplish this hard water displacement or rewashing, which is illustrated in Fig. 4 on the drawing, the hard water is admitted through pipe line 11 and 10 and passes down to the bottom of the softener, out through the notches in ring 21, upwardly through the screen, through the gravel layer through the zeolite bed, out of the top of the softener through pipe line 9, 8, 17, to waste until the effluent is soft, at which time the softener is again ready to be placed in operation.

Now, with reference to this diagram I have just been considering, these devices that resemble circles with crosses through them, are just turn-on and shut-off valves. The
48 symbol *c* indicates a condition of closure and the symbol *o* the condition of being open.

I have prepared sketches to show what changes would be necessary in the defendant's down-flow softener of 1925 to make it into an up-flow softener of the 1927 variety. This sketch which I have marked number 1 in the upper right-hand corner is an illustration of the Graver 1925 down-flow softener. I have noted on this sketch with red arrows the positions to which two valves would have to be changed in order to so arrange this softener that it could be operated as an up-flow. In order to make that clearer, I have illustrated the softener with the valves in those new positions on this second sketch marked number 2 in the upper right hand corner. With this new location of the valves the pipe line that was formerly the hard water inlet now becomes the soft water outlet, the pipe that was the soft water outlet is now the hard water inlet, so that this softener can be operated as an up-flow softener.

The Court: Those are the only changes necessary?

The Witness: A change in the position of these two valves and the change or reversal of the soft water connection with the hard water connection.

49 I have prepared also a third sketch, which illustrates how the softener of the type illustrated on sketch number 2 could again be changed so as to operate down-flow. This change I have again illustrated in red. It shows that by connecting the soft water outlet to the pipe which comes out of the bottom of the softener instead of to the position it occupies on sketch number 2 we have a softener which can again be operated down-flow.

(Three sketches made by witness Tiger received in evi-

dence and marked PLAINTIFF'S EXHIBITS C, D and E.)

Now, on the three drawings which I previously explained, the lightly dotted area at the right hand side of those various figures of Plaintiff's Exhibits 14, 15, and 16 on the injunction motion, illustrate approximately the position and extent of the zeolite beds as they are in the defendant's softeners and above that dotted area on the right hand side of each of those drawings is space.

Cross-Examination by Mr. Byron.

50 Mr. Byron: Q. Your position, Mr. Tiger, in discussing these three free hand sketches and the necessary changes to change from an up-flow to a down-flow by shifting the position of a few valves and changing the piping a little bit indicates, I suppose, that you take the position that there is no difference between an up-flow softener and a down-flow softener, is that correct?

Mr. Cooper: Your Honor please, there again I am not calling the witness on any matter of opinion, but simply on a matter of fact.

Mr. Byron: Well, they have talked about the same thing.

The Court: I understand the examination of this witness was confined to the question of how he changed it from one form to the other. He gave no statement of any conclusion or any opinion upon his part as to whether or not the change constituted invention or whether it had any significance at all.

Mr. Byron: Q. Then the change is a simple one, is it?

A. I would say it is.

Q. And you would say that a plumber could make those changes?

51 Mr. Cooper: There again I will make an objection.

The Court: Sustained. This witness simply answered this question. He says, "I changed it from that" and then he said he changed it from "this to this." "I changed two valves and changed my connections on the soft water and the hard water and I made it from a down-flow to an up-flow." He did not express any opinion about it, but merely stated a fact.

Mr. Byron: Q. In connection with Plaintiff's Exhibit 16, plaintiff's injunctional motion, you stated with respect to Fig. number 4 that the back-washing or re-washing, as it is called in Fig. 4, the function of that was to wash out the

hard water above the bed of zeolite into the waste pipe, is that correct?

A. That's what I said.

Q. Now, if there is salt in the bottom portion of that casing during that re-washing operation, that salt will have a regenerative value or effect upon the upper layer of hardened zeolites, will it not?

A. That would depend upon a number of factors.

Q. I said, if there is salt it will have a regenerative effect?

A. That will depend upon several factors.

Q. What are the factors?

52 A. It would depend upon the extent of exhaustion of these upper layers of zeolite and it would depend upon the strength of the brine solution and it would depend upon the quantity of the brine solution and it would depend upon the rate of passing that brine solution upwardly through the bed and it would depend upon the distribution of that brine through the bed and perhaps some other factors that I don't think of offhand.

Q. Well, if all these conditions existed, you would get a regenerating action, would you not?

A. If all what?

Q. If the conditions which you mentioned prevailed.

A. I did not mention any conditions. I don't think I mentioned any conditions.

Q. Well, you say under certain conditions is so and so were a fact.

A. I mentioned they were factors which involved whether the brine would regenerate or would not, but I did not mention any conditions.

Q. Well, on the assumption, then, that there was a sodium salt solution sufficiently strong in the bottom of the casing to have a regenerative action on that upper layer of hardened zeolites, when that sodium salt solution is washed up through the bed it would then regenerate that hardened layer of zeolites, would it not?

53 A. If the zeolites were hardened and if the sodium salt solution were strong enough to regenerate the zeolites and if the sodium salt solution came in contact with the zeolites it would have some regenerating effect.

Q. Referring to Plaintiff's Exhibit 16, offered on the motion for preliminary injunction, the pipe 10 which extends upwardly, according to the sketch upwardly, centrally of the

casing, is not connected to the lowest point of the casing, is it?

A. It is according to what you mean by the word "connected."

Q. I am asking you whether or not that pipe 10 is connected to the lowest point of the casing. The answer is yes or no.

A. Why, the pipe is not physically connected to the lowest point.

Q. It is not connected to the lowest point of the casing, then, is it?

54 A. Not physically connected to the lowest point.

Q. That's the best answer you will give the court, is it?

A. That's the best answer I can give, yes, sir.

Q. It is not mechanically connected to the lowest point of the casing, is it?

Mr. Cooper: Is not the question how far the outlet of the pipe is from the casing?

The Court: It is practically obvious to the Court that the pipe does not rest upon or touch the lowest part of the container. Therefore it could not possibly be connected with the lowest point of the casing. It is perfectly obvious to me, and I don't need this witness or any other witness to tell me it is or it is not. The diagram shows itself that it does not touch the bottom, it rests upon something else. Let's not waste any time and don't quibble, Mr. Witness.

The Witness: (Continuing) Now, that back-washing to which I referred in Figure 4 of Plaintiff's Exhibit 16, is a back-washing in the usual manner, there is nothing peculiar about it, at all. With respect to Plaintiff's Exhibit 15, the bach-washing in Fig. 2 is done in the usual manner; there is nothing peculiar about that.

55 The plaintiff's business for the year 1928 was $2,500,000 and the rest was made up by the business of licensees. Now, then, this plaintiff, in addition to manufacturing tanks in which zeolites are disposed, also is in the business of producing zeolites and selling zeolites as such. And the zeolite business as such, as distinguished from its tanks, is included in this large sum of $2,500,000 to which I refer. I believe I stated that licenses under this Gans patent in suit have brought in six hundred to seven hundred thousand dollars a year, we will say for the year 1928. Licensees pay on up-flow softeners exclusively, so far as I know. I am of the

opinion, then, that an up-flow softener is commercially operable for producing good commercial results.

The good result in the textile industry, for example, is a result directly of the softening ability of the zeolite water softener system. The zeolite mineral itself cannot soften the water unless it is placed and made into an apparatus.

Mr. Byron: Q. Please state whether or not zeolites are capable of softening water.

Mr. Cooper: That gets on the expert side, if your Honor please.

Mr. Byron: This man was qualified as an engineer.

The Court: He has not testified to anything on direct to make that proper cross examination. This witness has testified here about certain facts. He has testified as to how
56 he understands these particular water softeners illustrated in these particular exhibits used in the temporary injunction case 14, 15 and 16 operate.

Mr. Byron: That is true, your Honor.

The Court: He has not told why they operate so. He has traced the course of the water.

Mr. Byron: Has not he also, your Honor, stated the great commercial value of these things?

The Court: He has testified that they sold last year some $2,500,000 worth of products and that the licensee sold some $600,000 worth.

Mr. Byron: And that the textile industries were located in places where there was hard water because they could use this zeolite water softener for softening the water.

The Court: Yes.

Mr. Byron: Now, I want to know if it is the zeolite that softens the water or the casing of the softener that softens the water.

The Court: You are wasting our time on that.

Mr. Byron: Possibly so, but I would like to get an answer, if I can.

The Court: Sustained. I understand there is not any patent on these zeolites, on the product of zeolites.

Mr. Byron: Expired long ago.

57 The Court: That's what I mean. There is no present, no existing patent.

Mr. Cooper: Oh, there is in some forms.

Mr. Wilkinson: May I ask just a question?

The Court: Yes.

Mr. Wilkinson: Q. The advantage to the industries that you have referred to as being capable of location where

there is merely hard water and not soft water is due to there being available a suitable and satisfactory water softener, is that correct?

A. That's it, precisely.

58 EDWIN W. HAMMER, being first duly sworn, on behalf of plaintiff, testified as follows:

Direct Examination by Mr. Cooper.

My name is Edwin W. Hammer, I am a consulting engineer, with office in New York City. I am a mechanical engineer. I have given water softeners of the kind involved in this case, in their construction and application, considerable thought and attention. I was in attendance at the tests made at the plaintiff's establishment at Brooklyn, New York, the one set on the 27th of March, 1929, and the other on the 15th of May, 1929. There are separate stipulations regarding certain facts in those tests.

As a result of those tests in Brooklyn on those two occasions I came to very definite conclusions that there was no salt pool formed at the bottom in defendant's 1925 down-flow softeners and its 1927 up-flow softeners after the regeneration and washing.

59 The Court: In either one?

A. In neither one, and that none could be formed in either of those constructions under normal operation.

The Witness: (Continuing) There are several bases, for my statement of opinion, but I may say that the primary one comes from the fact that the pipe which opens downwardly near the bottom of the shell in the tank comes within a short distance of the bottom of the shell. Of course, it will be understood that if the open end—

The Court: How near the bottom does it come, in inches?

A. I understand it is $3\frac{7}{16}$ths inches.

The Court: $3\frac{7}{16}$th inches?

A. Yes, and the pipe itself is a $2\frac{1}{2}$ inch pipe. Of course, the court will apprehend that if the open-ended pipe were brought down so as to press against the lower end of the tank, water would be prevented from flowing into the pipe.

The Court: There would not be any outlet?

The Witness: It could not get in or out. Therefore it is raised a certain distance and being raised a certain distance,

and a certain short distance, and there being a definite flow of water into it through that pipe it means that there is and must be a definite rate of flow of that liquid through that pipe.

I made a certain calculation which showed that at 60
60 gallons per minute, substantially the rate of flow used in these tests, there would be a velocity through that pipe of about 235 lineal feet per minute, in the pipe. And I also found that with that flow of 60 gallons per minute, which is a flow that must come through the crown ring which surrounds the lower end of that pipe and which separates the lower end of that pipe from the balance of the compartment, the water must flow through the openings in that crown ring at about 32 feet per minute. So that as the ring is 16 inches in diameter, there must be an increase in velocity in about eight inches from 32 feet a minute at the ring to 235 feet a minute at the pipe, which means a tremendous acceleration in reaching the pipe, which is an acceleration comparable to the action of a fluid in an injector or an ejector, with which the Court may be familiar and which will force everything that is in the neighborhood of the end of that pipe into the pipe, either as a result of a partial vacuum which you may consider to be formed, or by reason of the great molecular friction of one particle of fluid upon another. In other words, we know that if we have, say a bath tub, for example, full of water, the water has to run out and the same thing happens here and there is a tremendous acceleration within a very short distance. The rate of flow was a rate which was settled upon as a result of the general instruction of defendant's bulletins relating to these matters. We ran the water through as rapidly as possible.

61 The Court: Was that all the direction that was given?

The Witness: That was all the data that was submitted.

The Court: And in that process what size is the inflow pipe, two and a half inches?

The Witness: I believe it was the same size.

The Court: The outlet pipe was two and a half inches?

The Witness: Yes.

The Court: The passage was two and a half inches?

The Witness: Yes, sir; with the pressure that was available, and considerable resistance that was offered by the bed.

The Court: Of course, we might take a variable quantity, a variable weight, because if the pressure of the water supply system happened to rise, the capacity would have to be lowered.

The Witness: The court must understand that if a softener is installed in a location, for example in your home, and the sewer pipe is not large enough to carry off the effluent by the waste and the fresh water coming into the house is not coming through a pipe large enough to give the proper amount of water, the proper pressure, your device is not apt to work satisfactorily and to give you the results that are to be expected if you have a proper layout.

The Court: In other words, the pressure would not be, or the momentum would not be enough?

The Witness: No; it would not do its work properly.

62 This rate of flow which I have mentioned, was a quite usual rate of flow for water softeners of the size and kind that was tested there and is comparable to the size or area of bed that is employed because it is desirable to get from four to six gallons per minute per square foot of bed. That is a broad and pretty general rate to establish.

As the result of my study and examination of the various defendant's water softeners which are here involved, I would say as to the practicability of using the type known as the 1925 down-flow for an up-flow softening movement that there is nothing to prevent its use. It is merely a matter, as Mr. Tiger has pointed out, of connecting it up for that special purpose. The apparatus is there and adaptable to either use.

The Court: You agree with him that you can change it by changing two valves and two water pipes?

The Witness: Yes, sir. I make a similar answer with respect to the possibility of using the 1927 up-flow for the down-flow operation; these characteristics which are present in that tank assembled as it is make it adaptable for either use when properly connected.

Cross-Examination by Mr. Byron.

Q. Mr. Hammer, I believe you have made the statement that the size of the pipe through which the raw water

63 passes into the casing is the same size as the pipe through which the water is ejected from the casing?

A. Well, I am a little uncertain as to that. I do not remember whether it was two inches or two and a half.

Q. If you do not know, then your calculations may be wrong?

A. No. No; my calculations regarding—the calculations I have given were based on a two and a half inch at the exit.

Q. You don't know anything about the inlet pipe?

A. I cannot at the moment just remember what that was.

Q. You will agree with me, I assume, that you cannot put into the casing any more water than you take out of the casing?

A. No; but you can put it in at a different rate than you can take it out.

Q. But if the diameter of that ejection pipe is the same diameter as the inflow pipe and you have a steady flow of water through the casing, then the rate of flow through each of those pipes must be identical?

A. Yes.

Q. That is correct?

A. Yes.

Q. Regardless of how fast the water may go through the notches?

A. Yes.

64 Q. Then water going through the notches may go at a relatively high speed and then they are stopped, they cannot get out of the ejection pipe any faster than the ejection pipe will let it out; can it, or any faster than the water itself flows into the casing; is that correct?

A. No; it is not correct at all.

Q. If it is not correct, then you would soon have your casing empty of water, wouldn't you?

A. No; because you have the same amount of water going out as comes in, as you say. Now, the distribution of velocities in the path depends on the relative areas. You have a certain area in each one of these areas in the crown ring.

The Court: I think you both have the same idea, but you are talking at cross purposes.

The Witness: Possibly.

The Court: You agree with the statement he just made.

Mr. Byron: That is, the in-flow rate and the out-flow rate are identical.

The Court: Not necessarily.

The Witness: Not necessarily.

The Court: The inlet pipe may be of small diameter, because the diameter of the intake pipe and the outlet pipe have a direct influence or bearing in determining that.

65 Mr. Byron: That is correct; but we are going on the assumption these sizes are identical.

The Witness: You may make any assumption you please.

Mr. Byron: There is not much point in talking about

velocities and pressure unless we get down to something definite.

The Witness: (Continuing) Looking at plaintiff's exhibit 16, there are notches in the lower plate for permitting the passage of water down through that plate within the confines of the collar 21. So then there would be a flow of water down through that plate within the confines of the collar. That flow of water would have a tendency to slow up the water passing diametrically inward through that collar to the extent that there is frictional contact between those streams of water if they abutt each other to any extent, there will be a modification.

It is hardly among the possibilities with that special construction that the components of their forces in their various paths of movement may resist each other, although they may modify the relative velocities by reason of the angles of impact.

I think it is in a measure true that the water passing through that lower perforated plate within the confines of the collar 21 will have a retarding action upon the water passing diametrically through the notches of that collar. I would be inclined to think, however, that the opposite would be the
66 case in that the water flowing through the large openings might tend to dam back, and probably would materially dam back, any water running down through those two little components in the plate itself, because you have components there of nine square inches through which the water may pass readily, whereas those holes in the pipe are very small.

As a result of these different pressures and the component of forces, I would say there could not be a swirling action in there that is not a direct flow towards the ejection pipe; for it has what you call a hydraulic propulsion, which forces everything into that plate, because the velocity is high. I know it is true, as a matter of fact, as a matter of engineering experience, it can't be anything else.

My calculations, however, did not contemplate the openings through this lower plate 20, just above the collar 21, and that would modify these figures to some extent. Sufficient pressure of water is normally used in a softener to get the desired rate of flow.

I could not give a figure of twelve or fifteen or twenty or a hundred or three pounds because it will depend upon the depth of the bed, the size of the pipe, the length of the pipes and so on, but you must organize your system so as to get

enough water through there, irrespective of what that pressure is.

67 If we assume in the first instance that we have no inflow of water at all but that the tank is filled, I don't know how fast the water, based on my calculations will pass through these notches in the pipe as a matter of gravity action. I don't know what two pounds' pressure of supply water would do in that bed. I can't say what flow there would be if there were ten pounds' or twenty pounds' pressure or anything. I would have to make some observations and tests. The figures I have given are absolutely not purely theoretical. They are based on the amount of water flowing out of that device and on the size of the pipe and the amount of water flowing being in your possession, it is simply a matter of calculating the rate at which that water was flowing.

I don't know what the pressures are. In determining how much water was flowing in, the amount of water that is flowing in, the amount of pipe through which it passes, the pressure is a matter of indifference. If the pressure were five pounds and you increased it to twenty-five pounds, there would be an increased velocity, because there would be more water flowing. It does make a difference, but certainly with the actual amount of flow it is a matter of indifference as to what the pressure is that is forcing it.

68 I made my calculations upon the softener we used in Brooklyn in those tests, the defendant's up-flow softener. Collar 21 in that particular softener also had notches up around its upper rim, there were at least three and perhaps four notches having an area of two square inches each, and if that was the case it would slow down the velocity at the crown ring to increase the acceleration between that ring and the opening in the pipe.

If the water were flowing in through notches at the top of this ring and flowing down through the apertures through the plate 20, the total velocity of water or the total quantity of water passing through the lower notches would be greatly reduced because there are more channels through which a given quantity may flow.

I did not take the notches in the upper portion of the collar into account when I was figuring, because I recognized that not having seen those upper notches I did not know whether there were three or four or whether there were any actually there at all, but I made a calculation based on the four square openings of nine square inches each and with the full recognition that if those V-shaped notches were also there, whether

there were three or whether there were four, that the effect would be to change the rate of acceleration in the eight inches between that ring and the opening of the pipe. In other words, the rate of flow at each one of those openings would be slower,
but would still have to accelerate until eight inches suc-
69 ceeded it and to the 235 feet per minute in the pipe.

Q. Now, let's get this right here. We have water coming in the notches at the bottom of this plate at a certain velocity. I have just drawn a little sketch here. Now let's assume that we have some water flowing down in this direction (indicating), the water flowing vertically downwardly acting to overcome, to retard the movement of water in the horizontal direction, is it not?

A. I have already stated that it might have some effect of that nature but that the probability is that the main flow coming through those large openings would rather tend to dam back the flow through the little holes in the plate.

Q. Why do you say that; why shouldn't it be just as much the other way?

A. Not at all. The one is a little volume and the other is a large volume, and the big fellow is going to have the major effect.

Q. Did you measure the apertures in the plate 20 to determine that fact?

A. No.

Q. Then how do you know?

A. Because I know they are small and I know that the others are big.

Q. An eight or three-sixteenth?

A. Three square inches in these four openings.

70 Q. As a matter of fact then, you do not know the actual condition which existed down there as to measurements of apertures, all of the apertures?

A. Not in detail, but I know pretty exactly what happens there.

Q. Well, now, Mr. Hammer, what would be the effect if some of the notches in the lower portion of the collar 21 were plugged?

A. It would increase the rate of flow through the other remaining openings.

Q. Yes. Well, now, explain to the court just why there was a ribbon of paraffine down inside of the bottom of that casing in the first test and found directly opposite the notches outside of the ring, as set forth in the first stipulation?

A. Of course, I do not know the precise facts certainly,

but I have a very definite idea as to what happened, which I would be glad to give you if you want it.

Q. It would increase the velocity, according to your idea of things, of the water passing through the remaining notches?

A. If that was present when the flow was taking place and it tended to dam up one of those openings, yes, but I don't think that was the case.

71 Q. You do not know?

A. Nobody knows.

Q. Well, you do know this, do you not, that at the close of the test defendant requested the privilege of feeling up into the bottom of that casing; that the privilege was granted to Dr. Moses, an expert, practical expert for the defendant. Dr. Moses pulled off his coat, got in the casing and opened it up. After it was opened up he reached up into that opening and felt around the collar and pulled out a great big crumpled ribbon of paraffine, just outside of the notches of that ring, don't you?

Mr. Cooper: Don't say great big crumpled ribbon of paraffine. Say what it was in dimensions, if you know.

Mr. Byron: Did you bring it with you?

Mr. Cooper: I mean there was some statement. If you are going to make any mention of it, I am perfectly willing to have it stated in size, but not in a pictorial way.

The Witness: Perhaps it is just as well for me to explain that situaiton, as I understand it. It may save a great deal of trouble.

Mr. Byron: Yes, I think it is rather embarrassing. I think you better do that.

A. In the actual construction that was used in Brooklyn there was an opening, an artificial opening made at the

72 very bottom of the tank and a plug had been made to fit in that opening, the purpose of that being to give an opportunity for connecting a test valve at that point so that the fluid might be drawn off at that point. It had been arranged that when that plug had been inserted in the opening the space above it should be filled with paraffine so that the surface at the top of the plug would be flush with the inside bottom of the tank. In other words, the paraffine was an artificial floor for the tank at that particular point.

The Court: How big was the plug?

A. Oh, in the neighborhood of three or four inches in diameter.

The Court: And when it was inserted do you mean to say

that there was a discrepancy between this top and the floor of the container?

A. Yes, sir; which was filled in by paraffine so as to restore as nearly as possible the natural configuration.

The Court: No declivity.

A. Right. Before Mr. Moses made this observation to which the question refers, that plug had been withdrawn and that ribbon of paraffine that was left behind, which I am positive was a ribbon which was cut out of that artificial floor by the process of removal of that plug and was not a ribbon of paraffine that could have gotten in there in any other way, now where the doctor found that ribbon I do not know,
73 but I am positive that there was no ribbon at the time the test was made and that the ribbon was a consequence of taking out the plug and nothing else.

Mr. Byron: Q. Now, as a matter of fact, do you recall when that plug was taken out whether or not the paraffine around the rim of that plug was smooth and discolored into a sort of a bronze yellow and did not show any marks of a new cut on it?

A. No; I do not recognize any such condition.

Q. Well, if that plug were removed from the central opening could it be possible in withdrawing that plug downwardly in this direction (illustrating) that the paraffine might get away from here on that outside of the collar.

A. Yes; when the doctor put his hand in there and reached around.

Q. That is, you think he was a little bit dishonest about it?

A. Oh, absolutely not; but I think it was a natural consequence of the mechanical reaching in there that that thing happened.

Mr. Byron: That is all I want to say on that point.

Mr. Cooper: Here is a photograph of the piece of paraffine. Do you want it? (Exhibiting photograph to Mr. Byron.)

The Witness: (Continuing) Referring to plaintiff's test of defendant's up-flow softener of March 27, 1929. At the end of fifteen minutes, at the end of fifteen minutes down-washing, it is stated in the stipulation that there were 220 parts
74 per million of chloride in the bottom of the casing, not 220 parts per million chlorine. The difference between chlorine and chloride is that chlorine is a constituent of chloride. It is expressed by the chloride radical CL. Then at the end of the twenty minute wash there were still forty-six parts per million. I should say that was neutral water for water softener purposes. Forty is the same as zero so far as the chlorine is concerned; the saltiness, you know, we can-

not tell from those figures. At the end of twenty-five minutes there were seventeen p.p.m. of CL; that indicates that there is something down there that is not just plain water, that is, there is some CL there, just as there is some CL in every sample of water everywhere.

Then, after that twenty-five minutes of washing there was a fifteen minutes lapse, and as a result of that fifteen minutes lapse the concentration of the solution at the bottom of the casing increased up to 22 p.p.m. of Cl, at the side of the tank above the plate.

Q. All right. Now, what is that 20, what does that indicate, side cock R is that at the side or at the center?

A. That represents a sample that was taken from the bottom of the tank just inside of the crown ring that we have talked about.

Q. Just inside of this crown ring here (indicating)?

A. Yes, sir.

75 Q. All right, that is an increased concentration, be it ever so small, that is an increased concentration, is it not?

A. I will not say so, because at that same time at the center cock, which is at the exact center, there was less salt than there was in the effluent, the effluent was 17 and here we have something at 16.

The Witness: (Continuing) The next fifteen minute mark, at the center cock, at the end of the second fifteen minute time there was 27 p.p.m. of CL., that shows that some of the salt in the tank had worked down, worked its way down into the floor down below. That shows that after 25 minutes that concentrate was at about the figure of 50 gallons per minute, there was salt in the bed which was now settled down into the casing. And the side cock at R shows 32 p.p.m. of CL. The 27 p.p.m. is at the exact center, but 32 is just inside of the ring and the 29 is up on the side of the tank.

Now, then, another fifteen minutes lapse. At the bottom of page six of that stipulation. And then at the center cock that concentration increased to 52 p.p.m. of CL. That means still more salt was coming down out of the bed even after the twenty-five minute washing. There is no doubt there was a little more salt then than any other time, but at the same time we must remember what a very small amount of salt 52 or 16 or 17 parts per million may be. It is almost in-

76 finitesmal. For example, I think it will be of interest for me to show the court what 8000 parts per million of actual salt was when taken from the center cock at the end of

the test, where there was the greatest concentration, due to the fact that there was a vermiform appendix where the fluid could not get out, and I will hand that to the court for his observation, 8000 per million.

Q. I think I can show a sample for that myself. Now, then, after all of this washing downwardly for twenty-five minutes, it was then necessary in order to get the salt out to wash upwardly, and, as a matter of fact, it took ten minutes of upward washing to get the water in the same condition in so far as chloride or chlorine content is concerned in the effluent as in the incoming pipe; that is correct, is it not, ten minutes?

A. No; less than ten minutes that took place.

Q. I am just taking the stipulation at page 7.

A. Well, yes, in effect you are right. In other words, at the end of ten minutes conditions were the same, the inflow and the outflow, but I want to say right there, Mr. Byron, I think it is necessary that I should, that that result was not dependent at all upon the effect of anything that had been in the bottom of that tank.

Q. Why not?

A. Because that water had not gotten up there.

77 Q. What water had not gotten up there? You mean to say that it would take over ten minutes for the water in the bottom of this tank to get to the bottom of the tank?

A. I mean this: That there was in that tank a condition of softness which is not represented by these 6 or 10 or 12 parts per million chlorine; that was reached before any of the fluid in the bottom of the tank reached the top of the tank. In other words, soft water, what your associates call soft water, commercially soft water, was obtained before the water in the bottom of that tank got to the top of that tank, so that for the purpose of water softening or regeneration, the water in the bottom of that tank had nothing to do with it.

Q. Well, frankly, I do not know what you are getting at, but I will ask another question. Water passing upwardly through the bed of zeolite will carry salt with it and do something. Is that what you have in mind?

A. It may or may not, depending entirely on circumstances, and I don't believe that any small amount of salt that there was in that tank had anything to do with any regeneration that took place. What happened there in that second wash was that the hard water plugged at the top of the tank, was drawn up and sent to waste, and it went to waste until soft water was recognized, when it was available to get into

the distribution system, but until that soft water condition had been reached by getting rid of the hard water plug at the top, none of it went into the circulation.

78 Q. In this medicine bottle that you showed to the court, in how big a sample was that salt present?

A. Eleven cubic centimeters.

Q. Eleven cubic centimeters?

The Court: What was the content of the water, hard water, that the chlorine passed into this sample, do you know?

Mr. Byron: Six p.p.m.

The Witness: That was the chloride content of the water.

The Court: Yes.

The Witness: But that did not represent the hardness of the water.

The Court: I understand, but I mean so far as the chlorine was concerned, that was the per cent?

A. Yes.

Mr. Byron: After that twenty-five minute wash.

The Court: The question was how much chloride was in the water?

Mr. Byron: Q. Now, Mr. Hammer, if we had a plain water, hard water, rinse water and passed—referring to plaintiff's exhibit 16, and passed that water upwardly through the soft bed, which is soft with the exception of an upper layer of zeolite, will not that rinse water transfer from the soft portion to the hard portion as it may be just carried by that rinse water and soften—

A. No.

79 Q. —and regenerate the upper layer?

A. No; I don't think so, and if you want the reason for it I can give you the reason. For general regenerating purposes it is necessary to have half a pound of salt for every one thousand grains of hardness that has to be removed, and under those circumstances we had here fifty cubic feet of zeolites, which represented 150,000 grains of hardness, or rather that was the capacity. If it absorbed 150,000 it required a half a pound of salt to regenerate those, which meant 75 pounds and actually 75 pounds of salt was used for regenerating purposes; 75 pounds of salt of 31 gallons of concentrated brine is quite a lot and is not comparable at all to the minute proportions that we are considering now. So that I do not think that there will be any regeneration or transfer on the way up through that bed by reason of the hard water that is admitted at the bottom.

Q. I suppose that you and your associate, Mr. Waterman,

who is also a patent expert in this case, agree on that matter, do you not?

The Witness: I can't give any opinion as to Mr. Waterman's views. If you should tell me Mr. Waterman took a contrary view I would want to read what he said before I passed on the statement at all.

Mr. Byron: Assuming that Mr. Waterman stated with respect to the Leister patent, and you recall that is a down softening machine an up regeneration and up washing, so as
80 a result in up washing the lower layer of zeolites would become hardened. Then when we start to soften water again by passing it downwardly through it, assume that Mr. Waterman said that the water passing downwardly through the soft zeolites would soften or tend to soften a hard layer of zeolites at the bottom; what would you say as to the accuracy of his theory?

Mr. Cooper: I think I will object to that. I don't believe the question in its present form is competent. What Mr. Waterman is assumed to have said is, to my mind, considerably hitched up with what counsel assumes he was talking about in his explanatory introduction.

The Court: Well, it doesn't make any difference whether Mr. Waterman said it or not. He may test his theory as an expert by the proper question, which submit a really hypothetical condition and whether or not he agrees with it he may answer that without reference to the question.

The Witness: I would only say that while the statement might be correct as to a tendency, the practical effect would be negligible.

Redirect Examination by Mr. Cooper.

The Witness: In my last answer, I was not carrying on the assumption all of the conditions that have been given in my preceding answer with respect to what was taken place in Brooklyn, I was simply taking the assumption as
81 stated that under some conditions there might be a tendency, but it would be so slight as to be negligible as a practical matter.

Attached to the stipulation relative to the first Brooklyn test is a drawing marked C 1941, and this drawing shows the center cock Q, which is the cock through which the 11 cubic centimeters were drawn which contained the small specimen of salt in the bottle.

As to what relation these 11 cubic centimeters bear to the

small pipe which terminates in that cock Q, it will be observed that there is a passageway leading from the bottom of the tank to that center cock Q, and it was calculated that the cubic contents of that passageway would be about seven or eight cubic centimeters and the effort was made to draw that amount of fluid out through the cock Q and to measure how much concentrated brine had gone down into that vermiform appendix, as I call it, and the fact was that we got eleven cubic centimeters in that sample and it was in that sample that we found there was a concentration of 8000 parts per million, because just above it it practically disappeared.

Mr. Cooper: Some reference having been made on the cross-examination to the paraffine sheets which was discovered in the bottom of this tank on the first test, that is, the March test, I will ask you if that was photographed upon a scale and if this is a photograph of the piece of paraffine.

82 The Witness: It was so photographed and I understand that is the photograph of that particular thing.

Mr. Byron: I do not want to be technical about that, but the witness says he so understands. If that is the best he can say, then I say it is objected to as hearsay.

The Court: Well, it is not offered as yet.

Mr. Cooper: No. I will have it marked for identification as counsel is somewhat extreme.

(The photograph was marked for identification "Plaintiff's Exhibit F").

Mr. Cooper: Does this photograph, plaintiff's exhibit F for identification, in connection with the scale on it, accord with your recollection of the size of the article in question at the time it came to light?

The Witness: Yes, it does.

The Witness: (Continuing) These opinions as to this salt pool which I have expressed on cross-examination and on direct examination, are not based altogether upon this first set of tests of March 27th about which I have been particularly cross-examined; we made another test on the 15th of May which was more restricted in the matter of time during which the washing action took place, but which reached the same general character of results. The results were of the same order as those found in the first test.

83 *Recross Examination by Mr. Byron.*

The Witness: 11 cubic centimeters is about a tablespoonful; to be exact, 11 cubic centimeters is 6/100 of a cubic inch; it is .06710.

The water which was used in both the first test and the second test for rinsing was the ordinary Brooklyn water, artificially treated for hardening it an increased amount, it had been raised to 312 grains of parts per million of hardness; all that appears in the stipulation. The ordinary hardness of the Brooklyn water is two grains per gallon or 34.2 parts per million. The Brooklyn city water was artificially hardened from 34.2 up to the figure 312.

All of the water was used from a single tank. The water had been especially prepared for before, a tank of water had been prepared with which to carry on these experiments, these demonstrations, and that water had a chlorine content of six parts per million and a hardness of 312. My recollection is the material used for hardening was calcium carbonate or sulphate, calcium sulphate.

84 I don't know whether you will find water in nature that is made up largely, so far as chemistry is concerned, of calcium sulphate. It is a matter of a gypsum deposit and whether the water used comes through a deposit, and so on, but I don't know to what extent you will find it. Now, in this water containing calcium sulphate, I don't know as rinsed through the soft bed in rinsing, what the calcium sulphate changes to.

Q. Well, there is sodium in the bed, is there not, that is the softening element in that bed?

A. Yes, sir.

Q. So your knowledge of engineering and being a scientific man, you would naturally suppose, would you not, that the calcium sulphate is changed into sodium sulphate; that seems reasonable, doesn't it?

A. That might be the case, but I don't know.

Q. Well, now, then, do you happen to know what effect sodium sulphate has upon the reaction to the standard soap test?

A. No; I do not.

Q. Well, what is the standard soap test to determine whether or not a water is soft?

A. There is a standard soap solution employed for the purpose known as B & B soap solution, generally commercially the rough test is to take a few drops of that B & B soap solution—

Q. You know it is five drops. It is five drops isn't it?

85 A. A few in a sample of 40 cubic centimeters of the water to be tested, and then a sample with this soap solution in it is violently agitated to see whether, as a matter of fact, a suds will be formed on the surface of that sample that will persist in the neighborhood of five minutes. If the amount used is five drops or less and suds are formed when agitated in a sample of 40 cubic centimeters, then the conclusion is that you have soft water.

The Witness: (Continuing) I don't know, as a matter of fact, that water containing sodium sulphate resists the soap test far more than any other water even in nature, I do not know that as a fact. What knowledge I have acquired about zeolite water softening and chemical reactions and one thing and another upon which I have been examined, is my knowledge which I have acquired in preparation for this series of litigations, to some extent, of course, but it is based upon the general information that goes back many years. It is not sufficiently great to pass upon chemical reactions and so on; I don't attempt to assume even to myself that I am a chemist. I know certain things that happened, yes, pretty thoroughly.

Q. You know that water is softened and that the bed can be regenerated and a few general things?

A. Those are little things I know.

Mr. Cooper: This is a general examination.

Mr. Byron: There are some very important general things I want.

86 The Court: The answer may stand.

Mr. Byron: Q. Your business is just acting as a patent expert in cases in which you are retained; that is correct: is it not?

A. When I am retained for that purpose. Otherwise I do general engineering.

Q. How much of your time is taken up with experting in patent cases?

A. About fifty per cent of my time.

The Court? What?

A. About fifty per cent of my time in actual testifying and preparing for testimony.

87 FRANK N. WATERMAN, being first duly sworn on behalf of plaintiff, testified as follows:

Direct Examination by Mr. Cooper.

My name is Frank N. Waterman. I reside at Summit, New Jersey. My office is in New York City. I am a consulting engineer.

Q. What are your qualifications as consulting engineer by training and practical experience?

A. I was educated in Cornell University. Then I took a course—

Mr. Byron: I am perfectly willing to admit his qualifications as a patent expert.

Mr. Cooper: I have not asked him at all about his qualifications for a patent expert. I asked his qualifications as to a consulting engineer. Will you admit them or do you want me to go on?

Mr. Byron: As a patent expert.

Mr. Cooper: I will insist on qualifying him. You should not interrupt if you are not going to concede the answer to the question.

The Witness: (Continuing) —in Mechanical Engineering. I also attended Brooklyn Polytechnic Institute where I took my Master's Degree, Master of Science. For a considerable number of years I was engaged in the practice of
88 my profession as an engineer in the design, construction and operation of machinery of various kinds, and in 1900 I started at my consulting practice, which has been widely varied, involving a great deal of design, construction and investigation work of appliances of many kinds. The investigation of the value and operativeness of new inventions, if there is any, in connection with the obtaining of patents, and in testifying and preparing for testimony in litigations involving patents.

I have had to do with this Gans patent and the industrial application of zeolites. I have devoted a great deal of time to the subject for a good many years. I don't remember exactly how many; I should say about twelve years, and I have testified in some litigation and given affidavits in others. I have made many tests and investigations of the operation of zeolites and water softeners and observed them in their commercial application in many different locations and uses.

I do not pretend to be a chemist. I had two years of chem-

istry in college, one year devoted to qualitative and quantitative analytical work, but I never posed as a chemist.

I have an understanding of the meaning of the terms hard water, soft water and zeolites as they are used in connection with a controversy of this sort. This term hard water is not definite, soft water is more or less definite.

89 The Court: They are comparative terms.

The Witness: Comparative terms and the term zeolites as used in this particular art have quite a definite significance.

The Witness: (Continuing) The zeolites that I have enumerated are of three types. The early type that we knew first and for a considerable number of years was known as the permutit. It is an artificial zeolite which is produced by a melting pot at very high temperature.

Then there is a zeolite which is hardly more than the natural mineral glauconite. It is often called green sand. It is made by an appropriate treatment of the natural sand.

And then there is another type of the zeolite which I have known chiefly as permutit P, which I understand is the same as the zeolite also on the market known as decalco. Those are both artificial products, made however not by heating but by chemical precipitation process.

The three different zeolites have the same type of zeolitic action, exchange action, but their physical properties are somewhat different.

For example, glauconite is the heaviest. It weighs, air dried, at about 105 degrees centigrade, if I remember rightly, about ninety pounds a cubic foot. And the permutit M, the early permutit, weighs not much more than half of that. Then the permutit P, and the decalco weigh about sixty pounds,

90 as I remember it. They are in other words somewhat heavier than the furnace product, but not so heavy as the natural product.

Q. I will first state to you an assumption, namely you may assume that the proper interpretation of Claim 1 of the patent in suit, is limited by a disclaimer to down-flow, and that the proper interpretation of claim 5, both claims involving a free space above the bed of the zeolite, so that the zeolite bed can be lifted or held in partial suspense; now upon that assumption I will ask you to make an explanation of the disclosures of the patent in suit with reference to what is particularly pointed out in these claims.

Mr. Wilkinson: I object to the question, your Honor. That question is really one for the court. It is a matter of in-

terpretating the claims of the court, rather than for an expert witness to advise the court how the claims should be interpreted. I have heard your question very clearly, and I think it is very clearly calling for the witness to do that which is the province of the court.

Mr. Cooper: I asked him to assume an interpretation of the claims, and then to assume the interpretation of the patent with reference to the matters that are covered by the claims. I did not ask the witness to interpret the claims at all.

91 Mr. Wilkinson: You are asking him to interpret the claims.

Mr. Cooper: I simply asked the witness for a classification of the disclosures of the patent.

Mr. Wilkinson: For an interpretation of the claim. You do not know whether the court is going to give that interpretation to the claims or not.

Mr. Cooper: I am taking a chance on that, just as if it was a question of insanity or otherwise, I put to the witness the assumption that the facts are thus and so. I am asking his opinion. Now, I am asking the witness on this assumption, which confines his attention to certain things, to explain what is shown in the patent.

The Court: Why can't you leave that assumption out entirely and ask him the question?

Mr. Cooper: I am perfectly willing to, so that we get back on the contentious ground as to what the claims mean, which is what counsel is trying to keep me out of, and what I tried to anticipate in the beginning.

Mr. Wilkinson: We shall leave that to the court, for the court to pass upon what the claims mean, and not the witness.

The Court: I think the question is quite ingenious.

92 Mr. Cooper: I suppose it was the sort of ingenuity that any counsel had to indulge for the purpose of putting a question to an expert witness. In other words I am perfectly frank about the matter, if your Honor please, I am taking the claims on the interpretation put on them by the court.

The Court: Now this man comes here as a witness for the purpose of interpretation of the patent?

Mr. Cooper: No I am not putting him on for that.

The Court: That is what you are asking him.

Mr. Cooper: No, I am asking him to explain the disclosure.

The Court: What is a disclosure? Your question is what do these claims disclose. Does that not mean to interpret? How shall these words be interpreted, these phrases, these clauses? What do they mean?

After all the question is what do these claims mean. Now, you are saying to him we will assume that these claims mean first of all that the conditions named in your assumption exist, we will assume that the claim means so and so; now with that assumption, what do the claims mean?

Mr. Cooper: If your Honor please, I do not want to worry about the thing at all. I am just asking a plain question.

Q. Will you please give a short explanation of the disclosures of the patent in suit, and you may confine yourself in explaining it as largely as possible to those things
93 that are referred to in claims 1 and 5, as distinguished from what may in addition be referred to in other claims which are not here in question.

A. I assume it is not necessary to dwell upon the nature of zeolites, or what is hard water. I will assume that water which does not lather readily with soap is water that needs to be softened, and is subject to treatment in a water softener, and the patent asked about discloses a water softening apparatus which makes use of the properties of zeolites in an efficient manner.

The zeolites have the property of exchanging bases. That is to say they can be conceived of as consisting of a sort of skeleton of silicate clothed with alumina associated with some other base, and if that base happens to be sodium or potassium, then when water containing lime or magnesium, the hardening constituents of water, pass over it under proper conditions, the zeolite will give out sodium and take in exchange the hardening constituents calcium and magnesia found in the water, and from this comes the name exchange base silicates, sometimes applied in lieu of the term zeolite.

94 The term zeolite, as a matter of fact, originally meant a mineral that boils when you heat it, but it was found that minerals having that property did have an exchange property, and those that had that property are more frequently called exchange base silicates.

This exchange takes place under quite definite chemical laws, and the apparatus to handle it effectively to produce continuous softening must operate in conformity with the fundamental laws of operation of material, and the patent therefore sets forth.

I call attention to page 1, line 19 that an apparatus is to be so as to be capable of continuous use, and again at line 28, whereby they can be continuously used. Again at line 100, capable of continuous use.

The patent in other words purports to set forth an apparatus in which this property of zeolites may be practicably useable as a continuously available apparatus not requiring a constant renewal of zeolites.

In relation to the character of the zeolites the patent points out that they must have certain physical as well as chemical characteristics.

I call attention in that connection particularly to the passage beginning at the line 30 where, in addition to the high exchange capacity for softening and high exchange ca-
95 pacity for regeneration, it is specified that they must be able to stand the physical abuse that is encountered in the natural operation. They must be large enough to permit the percolation of water therethrough, not material which would not allow the readily trickling of water through it.

The apparatus shown in Figs. 1, 2 and 3, consists of a casing having near the bottom a perforated metal plate *d*, and also near the top a perforated metal plate *c*. The bottom plate *d* has a layer of gravel or quartz upon it, upon which is the bed of zeolitic material indicated by *f*. The perforated plate *c* is some distance above the top of the zeolitic bed, and it carries a layer of quartz. It forms no part of the softener whatever, but the patent explains that it may be employed for the purpose of removing the mechanical impurities, mechanically introduced impurities as distinguished from chemically dissolved impurities, by what is often known as mechanical filtration.

The action of the zeolitic material is what I have sometimes referred to as a flying exchange. That is it is a contact phenomena which takes place as the water passes. It is therefore necessary that the water should have contact with the grains, which is of chemical intimacy, so that such an exchange can take place.

The Court: Does it take place almost immediately upon contact?

96 The Witness: It is almost immediate, yes. Very quick. And it is to impress that idea that I have called it a sort of flying exchange.

The presence of dirt on the surface of the zeolites makes that necessary intimacy of contact difficult.

The Court: Impairs the efficiency.

The Witness: Impairs the efficiency, and that is the purpose of seeing that the water is reasonably free from turbidity when it comes to the zeolite bed.

Figs. 2 and 3 are not especially involved in the claims 1 and 5, as they have to do with the stirring apparatus which the patentee says may be an advantage in connection with the back wash operation, which back wash operation occurs in the normal cycle of the apparatus for the purpose of freeing the zeolites from slime, turbidity and so forth that they may have picked up while the water is en route through them.

The softening operation is described, beginning for example at page 1 line 66. It passes in the pipe *k* in Fig. 1 up into the top of the softener out through that funnel shaped outlet indicated by the pipe *k*, and then passes down through the casing, encountering first the quartz bed *e*, and then after traveling a sufficient distance it comes down to the zeolite bed, and thence out, after passing clear through, and through the bottom strainer out through the conical screen *i* into the pipe *j*, and through the valve *n* to the soft water line.

97 The zeolites have a certain amount of exchangeable sodium, and in any given structure effectively utilize a certain proportion of that exchangeable sodium before water begins to show evidences of hardness, as indicated by the so-called B and B. That of course does not mean that all of the exchangeable sodium in the bed has been given up in any structure whatever. That is to say it is a physical impossibility in any structure to utilize all of the exchangeable sodium in the zeolite.

Now the efficiency of the structure is determined by whether it does or does not utilize to a practical commercial degree the exchange properties of the zeolitic bed.

Beginning at line 82 of page 1, the patentee says:

"After the softening property of the zeolites has been exhausted or reduced, which can be readily ascertained by testing the water passed through",

he then proceeds to describe the regenerating process.

In other words one user may have one standard of water that he wants, another may have another standard. If for example in a dye works it is extremely important that there never should be the slightest trace of hardness, then that only partially reduces the exchange power, because you would stop before the water ran hard at all. Or you might run until the water tested a little bit hard, and then regenerate. That is what I understand is referred to.

98 He then proceeds from that point on to describe the regenerating process through the rest of that paragraph. In the regenerating process water is passed from a suitable container, not shown, through the valve *o* as shown in Fig. 1, and passes thence up into the top of the tank in the same manner as the water did before, coming out through the conical piece *i*, and passes down through the casing encountering of course the several layers of material on the way, and coming out at the pipe *j* and passing to waste through the valve *p*.

This passage of the salt solution through the zeolite bed has the effect of reversing the exchange which took place during the water softening operation. During that operation the water was softened and the zeolites were hardened. During the regenerating operation the zeolites were softened and the water hardened. That process depends upon establishing a correct density grading, and the sodium zeolite takes calcium more readily than the hardened or calcium zeolite takes sodium.

The Court: Would you use sodium potassium or sodium chloride?

The Witness: Yes, either of those could be used.

The Court: Sodium chloride is mere ordinary table salt.

The Witness: Mere ordinary table salt, yes. In other words a fairly concentrated solution of sodium chloride is required for the purpose of rejuvinating the zeolites.

99 The Court: Do those zeolites continue year after year to retain the mechanical properties?

The Witness: Yes. They last for years, and that is the point of what the patentee says about continuous use, and of the properties that the zeolites have to have in the passage I called your Honor's attention to. That is they have to stand that usage for a long period. As the patent points out the bed has got to be back washed, cleaned. Back wash means the lifting of the bed by a current of water sufficiently strong so as to lift the zeolites, loosen them up, rub them together, and detach slime and all the elements that go to make up turbid water, and pass them to waste.

The difficult thing in any bed of that kind is to get water to flow through it uniformly. It is extremely difficult to prevent water from taking a preferred route, what is called channeling, and it is this raising up of the bed in back washing, boiling it, which makes it expand somewhere ordinarily in the neighborhood of 20 or 25 percent where the washing is quite violent, but say from 10 to 25 per cent increase in bulk

through this back wash operation, that gives the usefulness of the free space that appears in the patent, above the top of the permutit; the nearest obstruction above which in the patent is the grating or perforated plate *c*.

100 During that process the levitation effect of water is proportional, to the ratio of area to weight, and as all weight varies with the cube of the dimensions while the area only varies with the square, as the particles get square they get, from the patentee's viewpoint, lighter. That is the water levitates the smaller particles more easily than it does the larger particles, but it also gives a bigger area to accelerate. That is a bigger area in proportion to their weight. It simply follows from that natural fact that area varies with the square of the dimension and weight with the cube, so that the bed is arranged in virtue of that ability to expand, and channeling is prevented.

Now of course after the passage of the salt solution which I was considering a few moments ago down through the casing and out through the valve *p* the whole inside of the casing is coated with salt. The zeolites have salt solution adhering to them, the tank has salt solution adhering to it, and so it is customary to follow with a rinsing, rinsing out this adhering solution, and then the cycle starts over again.

It is important that the regenerating solution, which is strong brine, and which is also contaminated with hardness, should not get into the soft water line, and therefore the patent points out that it is important to be able to remove the contaminated solution; unwanted brine and hardening material should be capable of being removed from the bottom of the tank, the very lowest point in the tank.

101 I think I have now referred to all of the features of the construction which according to my understanding are indicated by the descriptive language of the claims 1 and 5.

102

Wednesday, October 30, 1929,
Ten o'clock a. m.

The Witness: (Continuing) I shall explain a little farther the matter of channeling on which I touched somewhat yesterday; channeling is a phenomena occurring in the filtration of water through zeolites, which means the selection of preferred courses through which the water may run to a greater extent than through the rest of the bed. The effect is to tend to enlarge such channels and to quickly exhaust

the exchange capacity of the zeolites along such paths and therefore to pass untreated water, unsoftened water, directly through into the effluent. The formation of channels is due to a number of causes, in fact the whole subject is rather a complex one. It is due, to, for example, unequal resistance of the bed, due to lack of grading or due to the very inclusion of air or the speed of air from the water passing through, to the accumulation of dirt or to anything that will cause or promote bacterial action under which the zeolites tend to adhere to one another and form so-called mud balls. All of these effects are causes of channels and there are perhaps others.

It is a phenomena that can be exceedingly troublesome and that is promoted by anything which constrains the bed. With appropriate grade of the bed in down-flow softeners this difficulty gives very little trouble.

103 I was present as it appears from the stipulations at the demonstrations in Brooklyn on March 27th and May 15th.

As a result of those tests I would say as to the presence after regenerating and washing of a salt pool at the bottom of the defendant's 1925 down-flow and 1927 up-flow filter that since the steps of regeneration and rinsing are the same in the 1925 and 1927 softeners, and the construction of the means for taking water from the bottom of the casing or the sand, it will not be necessary in making answer to distinguish between the two, and therefore while I shall refer, of course, to the tests which were made with up-flow softening, the answer will apply to both. In answering the question I will understand the word "pool" to mean a certain amount of liquid at the bottom of the casing, which amount cannot exceed that that would be contained in the casing below the bottom of the outlet pipe which contains more salt at the end of the downward rinsing operation than is found at levels higher than the bottom of the pipe.

The tests showed that no pool existed. Tests were run in somewhat different manners. There were two, one occurring in March and the other in May, and the first test was run in accordance with the instructions given in the bulletin of the Graver Company, which at that time I knew as Exhibit 12. On page 10 of the bulletin under the headings "3" and "4",

104 at the bottom of page 10, and which also bears the captions "Washing" and "Rewash", the instruction is given to wash with a downward flow "until test shows the salt is completely washed out". The first two lines of paragraph 4 then state:

"The softener is now reconditioned and ready for service."

After this operation was completed, the washing being carried on until there was a very small salt content as indicated by the chlorine test, the softener was allowed to stand for something over an hour, as I remember it. I can give the exact time by looking it up. The water was first tested, of course, immediately tested, and it was found that the salt content continually increased with time. Now, salt water is heavy, and the salt which was in the bed above this bottom part continually settled down into the lower part, thus showing that the space at the very bottom below the pipe had been drained out in the process of washing until it was of a much lower salt content than the space above, as indicated by the fact that when the salt was given time to settle down from above it did so and greatly increased the strength of the salt in the bottom. Of course, the total salt that was involved at any time was absolutely trifling. For example in the first test, the first sample drawn after the little petcock had been emptied showed 28 parts per million of chloride content, which was equal to about one-quarter of a grain or about one twenty-six thousandth part of a pound, which, of course, is a negligible amount of salt from the point of view either of salt or of any chemical effect that it would have upon the bed. It would have, in fact, no effect upon the bed.

105 The second sample drawn, the first sample was a little over a drinking glass full, the second sample was about a drinking glass full, was very much less salty.

The Court: Is not this shown by the stipulation?

A. Yes, in terms of parts per million, which is not very intelligible. I was merely converting it to grains. It was in fact, just about two-tenths of a grain.

The Witness: (Continuing) The second test was made for three reasons, first, a small shaving of paraffin was found in the bottom of the casing at the end of the test after the water was drawn off to permit inspection, and while I do not believe that that shaving was there during the test, nevertheless it did raise a question; second, the method of sampling left a small pipe sticking down which necessarily did retain some salt solution, and a different connection for drawing out water was arranged that did not require any paraffin and which had a perfectly flush normal bottom without the

106 use of paraffin, the paraffin having been used in the first instance for the purpose of making a flush, normal bottom in the casing. And it was decided also to adopt a dif-

ferent procedure and draw off the entire contents of the so-called pool and see whether it made any difference in the softening of the water. That is, in the subsequent softening of the water. And it was found that this drawing off of seven and one-half gallons, which is the maximum possible extent, allowing no space for the water to turn into the pipe which could possibly be called a pool, and this having been drawn off, it was found that the structure behaved exactly as before, the soft water came, and it was also found that the contents of the pool contained less salt than the effluent, showing that the connection by which water was removed from the tank was an effective connection to the very bottom.

Comparing the defendant's down-flow softener of 1923, its down-flow softener of 1925 and its up-flow softener of 1927 with the disclosures of the Gans patent in suit, as I have described them, I will assume that the structure is understood in each case and make the comparison with that understanding. Referring to the 1923 softener, as described in Exhibit 10, it comprises a casing within which there is a bed of gravel and on top of that a bed of zeolites or alumino-silicates, having the water-softening property. The piping provides a means for introducing water into the top and withdrawing it from the bottom for the softening cycle and for cut-
107 ting off that supply of water when the softening capacity of the zeolite bed is exhausted, and also it has means consisting of a tank in which salt may be dissolved and piping and means for forcing the salt solution through the piping into the casing for the regeneration of the zeolite bed and the structure is in all of these respects such as I have stated that I understood was disclosed in the Gans patent.

At the bottom of the casing there is a manifold of outlets which take water from the bottom of the casing and which enables the salt solution to be completely removed.

The 1925 softener is in general similar and what I have said applies to that softener with the exception of the construction by which the connection is made to the bottom of the casing in a functional or operative sense. In this instance the manifold which was found in the 1923 softener is not present and the concrete bottom which was present in the 1923 softener is omitted. Instead a pipe is taken into the casing and turned down towards the bottom and approaches within a short distance of the bottom. This may be seen from the cut on page four of the bulletin, which is marked Exhibit 11 in my copy. Surrounding the end of this pipe and about eight inches from its center I believe is a ring of

considerable depth, which forms a sort of local well around the end of the pipe and the bottom edge of this ring where it rests upon the bottom of this casing is notched to admit of the flow of water along the curved bottom of the casing.

Now, the water flowing in through the notches in the ring 108 has two effects. First, it is directed by the notches along the bottom, second, the total area of the notches is large as compared to the area of the pipe up which the water must flow. The result is that the water is directed along the bottom by the notches and is accelerated from a very slow rate where it passes through the notches to a very high rate where it passes into the pipe.

Now, in hydraulic design where water has to flow into pipes, the method which I was taught in college for doing that is illustrated on a small sketch which I produce, by which the so-called stream lines in which water naturally flows are approximated as nearly as possible. The method which I was taught was to take a center at each side of a pipe driven from the wall by the radius of the pipe, and with that point as a center strike a quarter circle, then with the same point as a center and the diameter of the pipe as a radius strike another circle and that is the distance controlled by this second water cycle. It is the distance in which water flowing freely would be drawn in a pipe up which there was a suction flow or a pressure flow. Now, that means that such a pipe free in the water is assumed to draw from a distance below its end equal to its own internal diameter.

Now, in this structure which is shown in Exhibit 11 the water is brought along the bottom of the casing. The water tends to flow owing to its momentum in straight lines, and as the bottom of the casing is continually curved upward 109 the water hugs the upper side of the lower wall or bottom of the casing and drives before it whatever was there originally. So that the flow up the pipe, which at the rate of 60 gallons per minute figured out, as Mr. Hammer gave it yesterday, I think it was 235 feet per minute, calls for an exceedingly rapid acceleration of the water as it flows in along the bottom and the connection which is made in this 1925 softener is thus operably a connection to the bottom of the tank of the casing, preventing the formation of any stratified pool of solution different from that going into the pipe.

(Sketch made by Witness Waterman received in evidence and marked PLAINTIFF'S EXHIBIT G.)

The Witness: (Continuing) Without repeating what I have said with respect to the 1923 softener, I will merely say

that according to my understanding of its functioning and according to the tests which were made at Brooklyn, this structure also has a connection to the lowest point of the casing for removing the salt solution. Of course, I do not say that that is a physical connection. The end of the pipe does not touch the bottom of the casing, but functionally it is effective to draw from the bottom of the casing as though it were in fact mechanically connected thereto in the manner shown in the patent.

The construction shown in Exhibit 12 illustrating the 1927 softener is in all substantial respects the same as that of the 1923 and 1925 softeners. There has been a slight modification of the piping by which the softener is more readily
110 adapted for up-flow softening, and the description which I have referred to on page 10 describes an up-flow cycle of softening, the regeneration and rinsing being conducted in the same manner as in the preceding 1925 softener, and the construction at the bottom functioning in the same way as I have just described with respect to that 1925 softener. There is, therefore, the casing, the bed of sand, or gravel, the zeolite bed, and means for introducing water for softening and withdrawing it and for interrupting the flow and for introducing salt solution for regenerating and for drawing the salt solution out from the bottom of the tank. According to my understanding of the constructions and of the patent therefor each of the three structures inquired about in the question is substantially such a structure as is described in the patent and functions in substantially the same way for the same purpose and result.

In all cases, that is, in each of three defendant's apparatus there is a free bed with a space above it in which the bed may rise and expand and be graded as I have described.

Cross-Examination by Mr. Byron.

The Wtiness: Referring to page 137 of the testimony which reads "This exchange takes place under quite
111 definite chemical laws," I was referring to the exchange of bases in the zeolites from sodium to calcium magnesia, and so forth; I say "this change takes place under quite definite chemical laws." I have in mind the law, if that is the proper word for it, of the affinity of the zeolites and the law known as the law of mass action in so far as that applies to this set of conditions that we are dealing with.

The law of mass action says that when one solution is submitted to the action of the zeolite, the other constituent is being understood for brevity that we are here dealing, let us say, with sodium in one and calcium in the other, the ratio of the two will be initially a certain value. The ratio at the termination of the exchange will be the same in the liquid as in the zeolites and equal to the original sodium-calcium ratio, modified by the greater preference that the zeolite shows for calcium as compared to sodium. Those are the laws that I had in mind.

I have no doubt about that that is the mass law but I suppose your use of the word "certain" might—

I did not bring any authority on that, but that's in all the books. The books of physical chemistry will give you the law of mass action and I myself interpreted that for the purpose of the particular conditions that we are dealing with.

Mr. Byron: Well, do you think that probably mass action might have something to do and primarily to do with the speed of transfer from one base to the other rather than all this that you have defined?

112 The Witness: Well, the law of mass action, of course, goes farther than I have stated.

Mr. Byron: That was not a complete answer, then?

The Witness: Well, I qualified it. Yes, I consider that was a complete answer. I qualified it as far as it has any application here in ordinary circumstances of use of the apparatus, as I understand it. Now, of course, time does enter and you might expand my statement of the law of mass action by saying that the speed of the reaction is in proportion to the relative concentration or the difference of concentration. I might add that the entire mathematics of the application of the law of mass action is rather complicated. Very early in my connection with the use of zeolites, I reduced those mathematics to terms which applied to zeolitic action and then made an elaborate series of tests to check up that application and the results of the equations were confirmed when the two laws that I have mentioned are taken into consideration.

Q. Now, what do you think about this law of mass action? This is in a book called "Outlines of Theoretical Chemistry" by Frederick H. Getman, published in the year 1922, and in that book on page 304 under the paragraph marked, "The law of mass action" in italics and quoting Guldberg and Waage, the mass action is defined as this:

113 "The rate, or speed, of a chemical reaction is proportional to the active masses of the reacting substances present at that time",
Do you agree with that definition?

A. Yes. My equations are based on that and conform to it, but it is only necessary to bear in mind to see what the application is that the rate, the time that is, in which the action may take place is determined by the rate of flow of the liquid through the casing.

The Witness: (Continuing) I referred in my testimony to this transfer as a flying exchange. That is, as I told his Honor yesterday, it is not instantaneous but takes place so quickly that there is no harm in regarding it as such.

On that same page, page 137 of the testimony, in addition to stating, "This exchange takes place under quite definite chemical laws" you continue to say, "and the apparatus to handle it effectively to produce continuous softening must operate in conformity with the fundamental laws of operation of the material." I will explain what I mean by that,—the matter of the free bed and the necessity for grading. Another matter that I had in mind was this, that if you take a pound of zeolites or a quantity of zeolites, let us say having an exchange capacity of 100 grains of calcium, in terms of calcium carbonate, and you take water having that amount of calcium carbonate or its equivalent and you stir them up in a bucket, stir them up violently, give them all the time you please and you will not get soft water. Although
114 the zeolite is capable of taking that amount of calcium out of water under suitable conditions, you stir them up in a pail and you will not get soft water. You will get about a 50-50 relation, that is, part of the calcium will go into the zeolite and part of the soda will come from the zeolite into the water, but it will not be soft. So that's one way in which you can not treat water with zeolites and get the softening action. I had in mind, therefore, the fact that under such circumstances as I have mentioned, if you want to get some soft water you must form the zeolites in the form of a bed, introduce the water in such a manner that it may flow evenly through the bed, and assuming the same conditions as before where I referred to mixing in the tub, you will then get soft water until the contamination produced, contamination of the zeolites produced by the softening action has extended through the bed and there has been some hardening action at the bottom, then the water will run hard and it will run progressively harder as that bottom layer begins to be more

and more contaminated. When the lime gradient, I will put it that way, the lime gradient in the bed, from top to bottom reaches the zeolites at the bottom, then the water begins to run hard.

115 Now, I spoke about these fundamental laws of operation and material and so on, I didn't say the patent therefore sets them forth. The patent does not go into text matters. Yes, I still use the words "And the patent therefore sets forth", because the zeolite has to be operated in accordance with the laws that govern its action. The patentee sets forth an apparatus which is conformable to those laws. Whether he knows the laws or not, he does set forth an apparatus which is conformable to those laws and in which the result, both of softening and regenerating, can be carried on as he says through continuous use.

Actually in the patent the tank is not given a dimension, it describes the structure and shows it in the drawing. It does not give the quantity of zeolite in the tank, that is immaterial. It does not give the rate of flow of water to be softened. It does not give the concentration of the regeneration solution to be used.

One looking at this Gans patent would not have to do more experimenting to soften water and to regenerate the exhausted zeolities, than is the rule in carrying out a patent.

Your statements are true, Gans does not teach how much zeolite shall be used, he does not teach what the rate of flow of the water shall be in softening, he does not teach the concentration of the salt for regenerating the zeolites, if by teach you mean going into the terms, statement by terms. If you mean by teach to be able to build an apparatus and operate it commercially from his patent, there would be no difficulty in doing that.

116 You call my attention to page 1, line 19, where he refers to an apparatus so as to be capable of continuous use, and ask whether the word "capable" describes in my mind any definite structure. I do not comprehend your question. The patent itself says, "The present invention has for its object an apparatus in which the zeolites or alumino-silicates can be used in a filter and be regenerated therein so as to be capable of continuous use for the softening of water."

Asked if Gans in his patent defines what he considers to be a capable structure, I point to the whole description of the specification and the showing of the drawings that the structure is such a structure. There is no difficulty about that.

I said that in the softening of water by means of zeolites and the regeneration of the zeolites by a sodium salt solution, it is necessary that the water should have contact with the grains; if they are separated by dirt or slime, the softening action will not take place. You ask if a particular portion of water to be softened does not directly contact with the grain, but there is an intermediate globule of water, will that transfer to the water to be softened the softening or sodium from the zeolite to that water to be softened; you are asking now apparently the ultimate mechanism of nature. I do not know that and, so far as I know, nobody else does. What authorities there are on that I do know, the thing I was talking about as a matter of experience, is that if your zeolite is coated with slime or dirt it won't exchange. That is all that I meant to convey. I had no thought of going
117 into nature's ultimate processes. That is to say, this property that nature has given these zeolites displays itself in this apparatus. Now, whether nature passes on the effect from molecule to molecule, I don't know, and I don't think anybody else does. But what I do know is that if you put an impervious coating around your granule, so that the water cannot, in the sense of an exchange, touch it, then you will not get the exchange. When I say in contact I mean in such contact as nature demands before the exchange can take place.

I have defined back-wash as an operation in the normal cycle of the apparatus for freeing the zeolites from slime, turbidity, and so forth; that is one of its functions. That same function is performed in the ordinary old sand filter in back-washing. And the old ordinary sand filters had a free space or a bed that is unconfined, free. So the function there is identical in so far as cleaning out dirt and slime from the filtering box.

On page 144 of my testimony I say that back-washing means the lifting of the bed by a current of water sufficiently strong so as to lift the zeolites, loosen them, rub them together and detach the slime and all the elements that go to make up turbid water, and pass them on to waste. When Gans speaks of back-wash he means that the bed of zeolites is capable and the conditions prevail for lifting and loosening that bed of zeolites up, to boil them up, the zeolites put in a state of semi-suspension and the bed expanded. Without stopping to look through the patent, because I have not read it from that point

of view, I should say Gans means that invariably about
118 back-washing; but I can't say that positively, of course, I don't know his meaning. If you will pardon me, I do not know what Gans meant and I have not undertaken to say. I only have intended to say what it conveys to me. I am explaining, and have been throughout, what Gans means to me.

Mr. Byron: All that Gans has to say about back-washing, regardless of what it may do, or any inferences we may draw as to what back-washing does, let us refer to page 1 of the Gans patent, the two last lines thereof, beginning at line 109:

"As shown in Figures 2 and 3, means may be provided for stirring the zeolites, as for example in washing, ('back-washing') to remove impurities mechanically taken up by the zeolites."

Then he describes the stirrer, and down in line 13:

"In back-washing the silicates by passing a current of water therethrough in the reverse direction from suitable connection in the usual manner for the purpose of removing slime, mechanically collected matters, etc. this stirring is advantageous."

So everything, all the attributes of this back-washing, which is referred to in the Gans patent, is done in the usual manner.

The Witness: Is that a question?

Mr. Byron: Yes.

A. Well, you can read it that way.

Q. Can you read it any other way?

A. Well, I have not happened to read it that way, but I see that you are quite justified in so doing. I read it "con-
119 nections in the usual manner." The Witness: (Continuing) Yes, it does speak about connections; from suitable connections in the usual manner. I had not thought of its meaning anything else, but I see you are quite justified in taking your reading.

Back-washing is done in sand filters with a free and unconfined bed and the back-washing in this Gans apparatus is in the usual manner as compared with the sand filter operation of back-washing.

Q. You say it is difficult to prevent water from taking a preferential route, what is called channeling, and this raising up of the bed in back-washing, boiling it, which makes it expand somewhere, ordinarily in the neighborhood of twenty or twenty-five per cent in the washing is quite violent, but say from ten to twenty-five per cent—

A. Probably when the washing is quite violent, twenty to twenty-five per cent, when the washing is quite violent.

Q. —in the washing is quite violent, but say from ten to twenty-five per cent increases in bulk through this back-wash operation, and that gives the usefulness of the free space that appears in the patent, the top of the permutit. Now then, your point there is that this back-washing destroys the channeling; is that correct?

A. It is not at all what I had in mind. What I had in mind was that it prevents it.

Q. What?

A. What I had in mind was that it prevents it.

120 Q. Prevents channeling?

A. Yes.

Q. Back-washing prevents channeling?

A. Probably minimizes it. What it does is to leave the bed in a condition of such uniform resistance that the channelling rarely takes place.

Q. Now then, that is upflow in the Gans apparatus in his back-washing. The conditions are stated as a result of back-wash that channeling cannot take place or very rarely take place; that is correct, is it not?

A. Yes.

Q. All right. Now let's stick to that. Now then, in upflow softening the water flows upwardly through the filter bed in exactly the same way as it is done in back-wash. Therefore in up softening the water will go up in a manner to prevent channeling, will it not, and channeling will very rarely occur; is that not correct?

A. Your question contains the tacit assumption that you are softening upward at a back-wash rate and upward softening at a back-wash rate does prevent channeling.

Q. What is the back-wash rate?

A. Well, I should say not less than four gallons per square foot per minute.

Q. Not less?

A. I do not think it would be effective back-washing at less than that.

Q. Yes. Now, in ordinary commercial machines back-washing is done at about the rate of fifty-eight gallons per minute, is it not?

121 A. Per what?

Q. Fifty-eight gallons per minute passes upwardly through the casing?

A. Well, it would not back-wash in some devices and it would flow others to pieces, that is, it could do it.

Q. I am referring specifically to your test, the plaintiff's test of the defendant's upflow softener at Brooklyn.

A. You mean a filter having about twelve and a half square feet of area, fifty-eight gallons per minute, which would be around five gallons per square foot per minute, would be a proper back-wash rate, yes.

Q. In the same test I believe you up-softened, plaintiff up-softened in defendant's upflow softener at the same rate of fifty-eight gallons per minute; is that not correct?

A. I presume so. I have forgotten exactly what the figure was, but that is what I should expect.

Q. All right. Now, then, on the single speed of flow of back-washing and the single identical speed of upflow in softening in the first instance you can get back-washing to wash out the impurities and to prevent channeling, and in the second instance you get a good action in softening the zeolites and preventing the channeling; is that not correct?

A. As far as the rate is concerned; yes.

Q. Well, so far as the results are concerned; let's get right down to brass tacks on this.

A. I am not sure.

Q. You don't know then?

A. I don't know what you mean.

Q. Oh, yes, you do.

122 Mr. Cooper: I don't like that remark. The witness says he does not understand.

Mr. Byron: That is perfectly clear.

I will ask the question again, if your Honor desires that I ask the question again.

The Court: It does not seem to me that it makes any difference whether you back-wash or whether you soften. The water proceeds through at the same rate, through the same substance and the same result is bound to occur.

Mr. Byron: Precisely.

The Witness: So far as the lifting and grading of the bed is concerned.

Mr. Byron: Q. I don't want to quibble, but I want to get in this word "channeling", and in so far as channeling is concerned.

A. Yes.

Q. Now then, you say it is extremely difficult to prevent water from taking a preferred course, what is called chan-

neling. Then you must refer to a downflow softener; tha
is correct, is it not?

A. No.

Q. What do you mean then?

A. Not having any reference to the direction of flow a
all.

Q. Well, you have just admitted that in upflow softenin
at the rates we have been talking about here, you actuall
prevent channeling?

A. Yes; and only at that rate.

Q. Oh, no.

123 A. Yes. I beg your pardon. Not oh, no. Only at tha
rate.

Q. We are referring to a successful commercial upflo
operation in the movement of the water upwardly throug
a bed of zeolites and that would prevent channeling and a
in this experiment. You have referred to a downflow softener
is that not correct?

A. Certainly not. I don't see how you can possibly dra
that inference. May I say that I am talking about what
assume you have been defining, entirely an upflow softene
at a backwash rate? My answers apply to that and to tha
only.

The Court: Well, but counsel assumes that the rate yo
have been talking about is a commercially successful opera
tion. Do you mean that?

A. That rate, yes, sir.

Mr. Byron: That is all right.

The Court: Then bear that in mind on this question. I
seems to me you have not answered Mr. Byron's question
directly. You have been quibbling on the questions. Th
question, as I understand it, is whether, assuming this to b
at the rate of fifty-eight gallons per minute in that commer
cial operation of an upflow softener is a successful commer
cial operation. Assume that fact and admitting that that i
the rate and that is a wise rate at which the back-wash oc
curs, does it not follow that the tendency toward channelin
must therefore be limited to downflow softeners?

A. No; absolutely not.

The Court: Well, why? I want to know that.

The Witness: Yes.

124 The Court: If you are back-washing at the rate o
fifty-eight and that prevents channeling and you are soft
ening at the rate of fifty-eight gallons per minute and tha
prevents channeling—

The Witness: I have been waiting for a chance to explain that.

The Court: I have not heard it. I have not heard any attempt on your part to do so, I am frank to say. Go ahead.

The Witness: Suppose that the upflow softener has no rate at that time.

The Court: Well, but the question assumes that it has. Don't you understand this question?

A. No.

The Court: I am saying that assuming your softening rate is fifty-eight gallons per minute and assuming that is a successful softening rate, and assuming further, as I understand you to say, that that is a successful rate at which you can back-wash, then you reach the same conclusion, do you not, that the channeling is prevented and reaches to a comparative medium by the softening process, as well as by the back-washing process.

A. Channeling does not take place at that rate, your Honor. I have said that repeatedly.

The Court: Yes; but then, if the upflow softener will successfully operate without channeling at fifty-eight gallons per minute—

The Witness: Or rather downflow.

The Court: —so far as that rate is concerned the only type is the downflow type, isn't it?

125 A. In downflow the softener works exactly the same.

The Court: But you have the channeling, you say, in the downflow type.

A. No; the channeling difficulty occurs mostly with the upflow type.

The Court: I admit, Mr. Witness, it is impossible for me to reconcile your statements with your present answer.

The Witness: Under the conditions of flow that are presupposed—

The Court: You have said to the contrary, if you analyze it. You said yesterday, you told the court yesterday that one of the great difficulties was in the flow of this water down through the body of these zeolites, there was a tendency of the water to seek a channel and a tendency toward a—

A. I did not intend to limit that to downflow. That is equally true of upflow unless at a back-wash rate.

The Court: You admit that the successful commercial rate is the same rate as a back-wash rate? You do not have any channeling, you just stay in the upflow rate, do you?

A. Very true, very true.

The Court: Then if you were to operate all these upflow softeners at a commercially successful rate, namely, fifty-eight gallons per minute, you would not be troubled about channeling?

A. No.

126 The Witness: (Continuing) There isn't any definite description in the Gans specification of the patent in suit about a free or unconfined bed except as it is implied by the rest of the description at the inside of the stirring, the description of the stirring apparatus. That language is not used, so far as I know, anywhere in the specification. Its equivalent is used, you have read it in part, where it describes the back-washing and where it describes the use of a stirring apparatus. You could not put the stirring apparatus into a confined bed. When Gans refers to back-washing, my interpretation is he means a free and unconfined bed—I inferred it from the drawings. Where Gans mentioned any place back-washing, my same definition obtained, that is, that the bed of zeolites is free and unconfined.

Mr. Byron: All right.

Now, at this point, your Honor, I wish to call attention to the fact that there has been more quibbling over a plain little German sentence than a German charwoman could translate, there have been seven experts on behalf of plaintiff in a lot of prior litigation, and five on behalf of defendant; in this case of Permutit vs. Wadham, plaintiff contended that a certain sentence there meant that the bed was absolutely locked, there was something, there was a screen down on top of the zeolite bed so it could not expand. Defendant's witnesses all translated that German sentence as meaning that the bed was free and unconfined, and so they are at a deadlock. Now then, in this same sentence, this same paragraph, Gans, who wrote that article of April 15, 1909, specifically refers to back-washing. Now, if Gans refers to back-washing and means in his patent a free and unconfined

127 bed, then by the same token in his April 15, 1909 article, when he refers to back-washing, he means a free and unconfined bed, and in that article you will find a more complete description, if you please, of this Gans device illustrated in the patent than his patent specification shows.

The Court: You may take that up in your argument.

Mr. Byron: Yes. I just wanted to make a point of it at this time.

The Witness: (Continuing) Referring to the tests of the

Graver upflow softener in Brooklyn. In spite of any speed of flow in the bottom of that casing and after twenty-five minutes of down washing, there was more chloride, you say, chlorine, I say, in the water in the bottom of that tank than in the water which entered the top of that tank. There was not a salt solution or some concentrate in the bottom of that tank, as distinguished from the rest of the tank.

No there was not some concentration in the bottom of the tank; there was salt in the water at the bottom of the tank, but the concentration was less than above.

I am talking about the free portion at the bottom of this casing where the zeolites are not located, down in the bottom of that casing, this space I have defined as a seven and
128 a half gallon space, the water, the solution in that basin of seven and a half gallons contained more chlorine or chloride than the water entering at the top of that tank, after a twenty-five minute down-rinsing; we did not carry it as far as specified, but carried it until it was successfully done.

Asked if in my opinion, as a result of continued downflow washing, you would ever be able to wash out all the excess chlorine referring to everything over and above six p. p. m., which was the chloride content in the incoming water, I would say it would take a long time. Of course, I can't say from personal experience with that particular softener, because the tests represent all the experience I have had with it, but I have had plenty of experience with a downflow softener and I know that if you tried to rinse the salt all out it would take a very, very long time. I assume the same thing is true here in the Graver upflow softener.

When I spoke of the figures in the first test I changed them from a quantity to a weight in order to get a ratio. Referring to a memorandum I will show how I worked out the calculation, this is the calculation that I made—28 parts per million is 28 milligrams per liter, and multiplied—there were 375 c.c. for .375 of a liter,—I multiplied that by 28 and got 10.47 milligrams of chlorine. Then I set up the proportion as follows: The atomic weight of chlorine is to the atomic weight of sodium chloride is as 10.47 is to X. From which I calculated that 28 parts per million chlorine represents 17.25 milligrams (NaCl) in the sample.

129 I converted that to grains by pointing off, and then multiplied by 15.43 and obtained .267 grains in the sample.

In these tests by plaintiff of Defendant's softener at Brook-

lyn, the Brooklyn water of 2 grains per gallon hardness was artificially hardened by calcium sulphate. It was so stipulated.

I do not know by my own analyses, what happens to calcium sulphate as it passes through a soft bed which gives up sodium but I assume it is converted to sodium sulphate, and that the calcium goes into the bed. I have never investigated what effect sodium sulphate has upon the standard soap test, in so far as the reaction is concerned.

I do not know that sodium sulphate resists the five drop standard B & B soap test by having tested it; I have understood that in sufficient concentrations it might. I did not suppose that in any such concentrations as we are concerned with it had any effect.

Assuming that it does have an effect to resist that action, you would have to wash water through the zeolite bed a greater length of time to get soft water when you used the standard five drop test, and where sodium sulphate is in the solution. My recollection is that we did not use the soap test, but the chlorine test in the Brooklyn test. But making your assumptions as to which I neither disagree nor agree, I assume that your conclusion would follow.

Q. Then obviously, if with that peculiar reaction under those peculiar circumstances, it takes longer to show soft water, under those circumstances, there was a greater
130 opportunity, was there not, to wash out of that bed and out of the water, a greater amount of salt than otherwise would have appeared?

A. Well, the tests showed conclusively the longer you washed the less salt, but the progress got very slow toward the end.

May I make just one statement to prevent misunderstanding, and that is I do not understand that sodium sulphate is hardness, or that it has the effect of hardness, in the matter of soap tests. I simply do not want to have you misunderstand me.

Q. Now, I am not discussing that matter, and I want you to answer my question.

A. I have.

Q. Answer it again then. I think that calls for a yes or no answer. I think there is no doubt about that.

A. I thought that was better than a yes or no answer, but I will say yes.

131 Mr. Byron: Yes.

The Court: Suppose he answers the question on the same basis, what it would mean to him.

The Witness: (Continuing) Asked if this patent means to me that it covers broadly the idea of softening water by means of zeolites I say, I have never considered it that way, but I should certainly say no. The patent broadly does not cover the regeneration of zeolites after they are exhausted, it includes that of course. On the same basis the Gans patent does not cover rinsing broadly, nor back-washing broadly.

You ask me if outside of the upflow type of softening being superior to the downflow type of softening, there is any other real difference in function in downflow and upflow softening and I say I do not agree with your premise.

Outside of the question of channeling, and assuming that the several steps of the designer are carried out with equal intelligence, there is no real difference in function in a
132 downflow softening operation and an upflow softening operation. The question of channeling is the chief difference, and that is greatly in favor of the downflow softening.

If you had an upflow water softener, piped correctly for upflow softening, it would not be a very difficult matter to change over to downflow softening.

You read me Mr. Hammer's statement in the Paige & Jones case, record page 94, where he said:

"Once Gans had shown that the way to make a successful zeolite softener was to leave the bed free and unconfined, the arrangement of the pipes so that the water would run one way or another is nothing but a plumber's job."

I do not know just what Mr. Hammer meant by this, therefore I do not know whether I agree with him or not, but after you once understand the art as established by this Gans patent, any one with the intelligence to comprehend it can lay out the piping for either an upflow or downflow. I do not want to pass on the intelligence of the plumber. I think plumbers are different. Certainly, I said if you tell the plumber what to do it is nothing but a plumber's job.

In an upflow water softener you are back-washing all the time. An upflow softener must work at a back-wash rate. Why! the upward washing is used in the Defendant's softener, but not at that rate. In other words, all through the normal use it is running at a back-wash rate. When they

push the hard water in the tank out to the sewer by an upward flow they do not have to use that high rate.

133 In a downflow softener, the water is softened as it goes downwardly, and I have stated that the water in passing downwardly through the upper sand filter will leave some of its mechanical impurities in the sand filter, but some will pass down to the zeolite bed. I have also stated that it is necessary to get rid of that dirt and slime so that the zeolites can be effective.

In the downflow type of water softener, in the bed of which there is collected certain slime, I would not say it is necessary to back wash that bed to carry out the dirt and slime at that time, before you can regenerate the bed of zeolites. It is proper. It usually is done at that time. Whether it is necessary to do it at that time depends on how dirty it is. I know it is not because I have done it the other way. I say that you have to wash the dirt out, but it is not necessary that it be done first, rather than last. It is preferable. In order to get the grains of zeolite to regenerate, you have got to take off their little overcoat of dirt if that overcoat of dirt is excessive.

Q. Well, if it is there at all you have to get rid of it before the regenerating solution will get through to that zeolite. You have to get rid of the overcoat of dirt, don't you?

A. Until the softener was performing—

The Court: Can't you say yes or no?

The Witness: No, your Honor, it is not a fair question.

134 The Court: I think to the contrary, Mr. Witness. You have testified at considerable length that the secret of the successful operation of that type of softener lies in the fact that the zeolites have a peculiar property of being able to exchange one chemical compound for another, and that it is necessary in that process to have contact, at least to a certain extent. Now the question is whether when you go to regenerate these zeolites, when you go to put them into position where they can make this exchange, you must have them in proper condition, must you not?

The Witness: Yes.

The Court: You must have them relieved of extraneous matter?

The Witness: Yes, but suppose—

The Court: Now, that is the question that is still to me. Answer it yes or no.

The Witness: Well, I will say no. In my own house it is not true. The water—

The Court: Why isn't it true? Now tell me that.

The Witness: That is what I am trying to do. Because the bed gets exhausted long before it accumulates dirt when the water is clear. Now in that circumstance—

The Court: Nobody said anything about that. We had water that was not clear. That was part of the question that was put to you, the assumption that the water was dirty, and that question is what you are to answer, and that condition has been in every question upon this subject for the last ten minutes, that has been put to you.

135 The Witness: I am sorry if I misunderstood your Honor.

The Court: You should be sorry. You have taken the time of the court because you have not understood the question which should have been clearly understood.

The Witness: May I hear it?

The Court: Re-frame your question please Mr. Byron.

Mr. Byron: Q. We are assuming, Mr. Waterman, that we have a bed of oysters, and the oysters, or at least some of them in the upper portion of the bed are clothed with dirt and slime. Now then we want to get rid of that dirt and slime before we regenerate, so to do that it becomes necessary to back wash that bed, to force water upwardly through that bed to remove that dirt and slime; is that not so?

A. Of course.

The Court: You might have told us that two minutes ago, Mr. Witness.

The Witness: I certainly should if the question had been the same. I did not so understand it.

The Court: The question was the same. I don't know why it is, but it is unfortunate that you either do not understand the question or you don't want to answer it correctly at different times.

The Witness: This is not the subject of the direct examination.

The Court: I want you to answer these questions in the way in which you understand it, and if you don't understand it, I am willing to let them put it before you until you understand what is meant by it.

The Witness: I have never understood your question.

The Court: I beg to differ with you on it.

The Witness: Beg pardon. I said knowingly.

The Court: Perhaps not knowingly. If you don't know you should know. That is the reason I say you should understand these questions. You have taken all forenoon for an examination that should have taken a half hour.

Mr. Byron: Q. In about how many patent cases have you been an expert witness?

A. I do not know.

Q. Several hundred?

A. I do not know. I never counted them.

Q. Now, getting back to the upflow softener, I started out twenty-five minutes ago to say that in the upflow softener, in the upflowing action of the water through the bed of zeolites, with that type of softener, it is not necessary to backwash, is it?

A. It is unless the softening is done at a back wash rate.

Q. Well, let us assume that the water is flowing at a rate sufficient to hold that bed in a state of semi-suspension, the one that we have assumed in general operation; under those conditions, with a bed of zeolites in a semi-state of suspension, any dirt or slime coming in with the water would go directly up through that bed of zeolites, would it not?

A. If that is true clear to the bottom of the bed, yes; otherwise not.

137 The Witness: (Continuing) When there is no dirt in that bed in the upflow softener, it is not necessary to back wash. I have no statistics which say that in an upflow softener, there is the economy of water to the extent of the amount of water that is used in back wash in the downflow. You have two washings in either case. I do not know the relative quantities of water involved.

Q. I have said for a long time now that in an upflow softener, in that up softening action, no dirt or slime,—we are considering that as settled—no dirt or slime finds itself in that bed of zeolites, and therefore you answer it was not necessary to back wash. Now then let us go to the Gans patent and the downflow. The water in passing downwardly through the bed of zeolites, dirty water, left dirt and slime on top of the bed or in the upper portion of the bed of zeolites. Now then we have to get rid of that dirt and slime in the down wash softener so we back wash with water. Now we used some water in back washing, didn't we?

A. Of course.

Q. And we did not back wash in an upflow softener. So the economic advantage in so far as wash water was con-

cerned, in the example I gave you, is in favor of an upflow water softener, is it not?

A. I don't know. You have not completed the cycle.

Q. Now, regardless of the cycle, in considering the same conditions, what is your answer? I am just speaking about the presence of a back flow washing and the non-presence of an upflow washing, the economy is in favor of the
138 situation in which no back flow washing is required; is that not so?

A. That would be true.

The Witness: (Continuing) I do not know why the plaintiff uses a duplex gauge or two gauges on its downflow type of water softener. In connection with plaintiff's downflow type of water softener I have seen that there is a gauge that measures the pressure of the incoming water, and that there is also a gauge which measures the outgoing water. I don't know whether it is universal or not. I don't remember whether I ever saw two gauges compounded into one gauge known as a duplex gauge or not. The function of that gauge or of the two gauges is to indicate the two pressures.

I understand that in an upflow type of water softener, assuming that the zeolite bed is mounted on a gravel bed, that the gravel bed in the use of dirty water, in the upflow will act as a strainer to collect any dirt or slime. I am sure I don't remember if I ever said that it does. I don't think I have mentioned it in this case.

139 Q. Please refer to the Duggan patent 1,276,629, which is called a prior art patent; this is one of the two patents that was involved in the suit of Permutit versus Wadham, in Detroit, in the Sixth Circuit.

Mr. Cooper: I object to this as beyond the scope of the Direct.

The Court: He may answer that, if he knows some other identification.

Mr. Byron: It is all on the same question of channeling with the locked beds. It is all interlocked. You cannot get away from it.

Q. Do you remember whether that was in the suit or not?

A. I don't remember.

Mr. Cooper: I will admit it was in the suit if counsel says that it was. That is a matter I don't know about, but if counsel says it was in the suit, I will admit it.

Mr. Byron: I will make the statement if you believe me.

Mr. Cooper: I am taking your statement.

Mr. Byron: It was put in the suit originally and it was withdrawn from the suit.

Mr. Cooper: That was before the trial?

Mr. Byron: It was during the trial.

Mr. Cooper: Well, I meant before the submission. It did not go before the court?

Mr. Byron: No.

140 The Witness: (Continuing) In the tests which I have made in an upflow softener where a screen was placed down on top of a zeolite bed, channeling occurs very markedly. I determined that there was channeling in that upflow softener in two ways. One by testing liquid at different parts above the bed, and finding that it differed, and second by using a glass container and using a colored liquid.

I have not tabulated those tests so that I can present them to the court. It was years ago. I have not forgotten the results. I could not tell you how many years ago it was. Maybe ten years ago.

Mr. Byron: Q. Do you agree with this statement, and it has reference to a zeolite type of softener, in which the top of the bed has pressed down upon it a screen. The statement is:

"The channeling difficulties are more accentuated where the flow of water to be softened is down through the bed than where the flow is upward."

A. Well, from the limited experience that I have on that, I do not agree with the statement that he read.

The Witness: (Continuing) In the first part of my testimony I said that I had been working on these water softeners for ten and a half years. Based upon that ten and a half years experience I cannot give an answer, my experience of lock beds has been rather limited, and the impression that I derived from it is that the reverse of that

141 statement is true. I cannot speak as of wide experience on lock beds.

The distribution of water uniformly over the area of the bed during the softening period in the downflow softener of the Gans patent, is secured by the uniform resistance of the bed, which comes as the result of proper grading of the bed in a back wash operation, as I explained.

I stated in all the litigations that even distribution was controlled by a fine layer of high resistant material on the top of the bed, that is the result of grading. I suppose such upper layer of highly resistant zeolites to be essential to the proper distribution of water in a downflow water softener,

to avoid channeling, but I do not know that I ever used any that did not have it. That is zeolites always differ in size and therefore there are always fine ones on top.

What I am uncertain about is whether it ever could be absent. Zeolites always have some fine particles. In backwashing they always take the top. And where I have deliberately disturbed that layer or where the bed is put in without any attempt at gradeage then a tendency to channeling follows:

As a result of back wash, in the Gans patent, there is formed on the top portion of the bed a uniform layer of high resistant material to uniformly distribute the water in its passage downwardly through the bed. I so regard it as necessary to prevent or to minimize channeling in a down softening action, in the Gans arrangement.

142 In an upflow water softener, that is a softener in which the water passes upwardly during the softening action, a layer of high resistant material on the top of the bed could have no influence or effect or control upon the distribution of that water passing upwardly through the zeolite bed, unless the rate was very low. Very little under any circumstances, probably none.

The distribution of the upflow water in up softening action, in an upflow type of water softener, would be controlled in the sense of distributing the water by some means below the bed of zeolites. I will explain, so long as the injection of water avoids a jetting action, that is so long as it does not produce a projection of water against a local spot on the bed, then the channeling is prevented, in working at a back wash rate, by the instability, the unstable equilibrium, of the bed.

The more closely the zeolites are held together the more effective will be the collection of suspended material in the zeolites.

I do not think that your statement is correct as a matter of mechanics, that in a downflow softener, the zeolites are held packed together because of their own weight, and in addition because of the weight of the column of water coming down upon them, but by whatever the loss of pressure through the bed is.

To the extent that the weight of the water so acts, it is correct that there is a cumulative weight, first the weight of

the material itself and then the weight of the water, to hold the particles of zeolites close together.

143 In an upflow softening action the zeolites are held in a semi-suspended condition, so that taking your fist as a grain of zeolite in a semi-suspended position, the whole surface of that grain is exposed to the water, of course the suspension is not complete; it is semi-suspension.

Now then in a downflow softening action, the zeolites are not in a semi-suspended condition; they are in a packed condition; therefore it may be true to a slight extent that there is less actual surface, zeolite surface exposed to the water passing downwardly through the bed of zeolites. Of course the grains are very irregular. They do not fit together as you illustrated with your fist. There is not proportionately a great deal of interengaging surface, in a zeolite bed of the downflow type. There is enough to sustain the pressure. I mean proportionately to the total surface. I really don't know whether it is true or not that there is less surface exposure of the grains of zeolite in a downflow softening action, than in an upflow softening action.

No, it is not necessarily true that the efficiency of upflow softening would be greater than the efficiency of downflow softening, due to the difference in surface exposure of the zeolites, there being more in the upflow than in the downflow, but if you assume that it equally effectively contacts, that is there is no channeling, the water is evenly distributed, then it may be true.

Mr. Cooper: The whole matter is speculative.

Mr. Byron: There is nothing speculative about it.

144 The Court: It seems perfectly obvious to the court that if you had a particle of sand with a zeolite on top and water on top of that, that the force of gravity of the material itself, the water on top of it, and the water flowing, would hold the material back. That is ordinary common sense and knowledge of the laws of gravitation. On the contrary if that water is forced up through a body of sand so that the values are in suspension or semi-suspension or in subversion, there is to a certain extent a counter action against the gravity, and the force of gravity is not exercised to the extent it is when it comes down, because there is something pushing against it. I do not see any necessity for any great detailed examination upon those things because those things are perfectly natural. It seems to me the witness should admit that.

In patent cases where you get on the witness stand gentlemen who are classed as patent experts or engineers, and testify as experts, time and again they are asked to testify to things that are largely matters that seem to me the court ought to have some knowledge about himself.

I repeat myself in statements in the past upon that subject, and I shall continue to repeat myself upon it as long as it comes back. I am asked time after time in patent cases to sit and listen to some gentlemen who I think has no more intelligence than I have on subjects regarding the laws of nature, to give sworn testimony as to perfectly obvious facts. I suppose counsel are always entitled to put in expert testimony for the purpose of explaining to the court that
145 which is difficult to understand, but no amount of testimony can change established facts, known to be true the world over.

It does not matter whether this gentleman accedes or whether he disagrees. The fact is that when water comes down into a body the force of gravity tends to pack it. The fact is that when water is going up it is counteracting to a certain extent the force of gravitation, and therefore the packing is less. It may reach the stage of complete suspension. It may reach the stage of partial suspension. I do not know what material those obvious facts are going to have in the outcome of this law suit. It seems to me perfectly obvious, if I am not assuming something that because of ignorance on my part is not obvious to others.

You may proceed.

The Witness: (Continuing) I am qualified to discuss this standard five drops of B & B soap solution as the determining factor of whether or not there is soft or hard water, I have done it many times. If you get a permanent lather with five drops of soap all put 40 C.C. of water in at once, you say you have soft water, but not zero. I have been accustomed to use three. If you need more soap the water is harder. Many use five, many use three drops B & B soap test in the commercial world to determine whether or not you have soft water commercially or hard water commercially. You never use more than five that I know of. I would not be surprised nor would I disagree if in an instance eighteen drops of this standard B & B soap solution were used to be the test of whether or not there was
146 soft or hard water, not if that is the kind of water the user wanted. Eighteen drop water is not soft water in ordinary tests. It may be soft enough for the purpose of

the man operating a filter that way.

If by this test five drops determine soft water, then more than that is harder than five drops of course. Hard is not an absolute term. I never have so understood it. If eighteen drops of standard B & B solution were used in forty cubic centimeters of water I would say from my point of view that you had hard water.

You read me what you say is a report of the Permutit Company dated March 16, 1927, to the Florida Filter Corporation, subject Health Refining Company, Tampa, Florida, containing two pages, on the second page of which, paragraph 10 it states:

"However the zeolite plant to follow can be figured on an adjusted hardness of 20 grains for this well water No. 1, capacity 20 grains, the special soap test, that is nine drops in 20 C. C."

I do not admit that that woud be a practical test for soft water or hard water. I assume that that assumes a brackish water, and you cannot do any better than that with brackish water oftentimes. But it is not soft water according to my understanding.

(Said circular was marked for identification Defendant's Exhibit 18).

147 The definition of a free and unconfined space perhaps depends on the point of view, but I should say room for the bed to expand and boil, when operated at a back wash rate, this is ordinarily above four and not exceeding six gallons per square foot of bed per minute. If you mean in a given tank, I suppose it is all the space from the bed up to the outflow.

A locked zeolite bed is one which is held so that it cannot expand and grade when treated with an upflow of water at a back wash rate. A locked bed is one in which the screen is right down on top of the zeolite bed so that the water in passing upwardly through the zeolite bed cannot substantially expand at all. If it can expand there is an unlocked bed, or a bed which is free and unconfined. A locked bed is one in which the zeolites are not free to have substantial expanding and grading.

Mr. Byron: I would like to have a definition of a locked bed without the word substantial in it.

Mr. Cooper: If your Honor please, the witness has given his definition.

The Court: He may ask him what he means by substantial, if he wishes.

The Witness: (Continuing) I mean by substantial in this definition that the expansion of the bed produces no material results that are different from what it would be if it was clamped tight, or the weight was right down on it. The primary differences between a locked bed and a free bed are that you cannot wash the locked bed and it does not grade. You cannot grade it.

148 The Court: He may tell in that respect whether he means by locked bed whether the locked bed is placed immediately in front of the top surface of the bed, or whether there is any intermediate space; what he means by the term locked bed.

The Witness: I mean that it is either in direct contact, so close that the expansion of the bed on a flow at a back wash rate cannot free the bed from dirt.

The Court: How much space would be necessary to produce that back wash?

The Witness: Ten to twenty per cent of the height of the bed.

The Court: Do you mean the vacant space between the top of the plate, the over-lying plate, to get 10 to 20 per cent of the volume of the bed?

The Witness: Of the height, the depth of the bed, yes. That is the height should be that much.

The Court: And if you have 10 to 20 per cent then you do not call it a locked bed?

The Witness: No.

The Court: With less than ten per cent you do call it a locked bed?

The Witness: I would not like your Honor to bind me down to that.

The Court: I am trying to get you two gentlemen at a definite point if I can.

The Witness: That is my estimate, of the minimum that would be effective, but I would not like to swear.

149 The Court: You have your opinion at this time that less than ten per cent would not be effective in the washing process, and that might therefore be termed locked bed?

The Witness: Yes.

Mr. Byron: It is a big issue in this case, your Honor.

The Court: He has given you his opinion on it.

In commercial use what is the depth of this body in the plaintiff's machine, do you know?

The Witness: Not less than two feet. From two feet up according to the size of the container.

The Court: Do you know when this is put into commerce how much the bed is, how much vacancy there is above the top of the bed?

The Witness: I have seen them, I think, all the way from two feet, usually not less than three, up to six or seven.

The Court: When the bed is two feet thick from top to bottom, how wide a space do you have above it free, normally, the average; the same?

The Witness: No. Oh, no, I could not say normally. Maybe 30 or 40 per cent.

The Witness: (Continuing) You read to me the following from my testimony in the Detroit case, on page 210:—

"Not only is the salt objectionable if the water is used for drinking or other purposes; but that the salt water, as your Honor remembers, has taken the lime, and the lime is what we want to get rid of, so it is very important that there should be enough washing done for each regeneration to insure that the lime holding salt has been gotten out, and it is for that purpose that the patentee emphasizes particularly
the attachment—attachment—of an exit pipe at the low-
150 est point so that there shall not be a pocket for the salt
to form. Salt water as your Honor knows is much heavier than plain water. That is why a person floats more easily when he is in sea water, and it will tend to hug the bottom, and even though there be quite a violent inflow, if the salt water can get to a point lower than the outflow pipe, it will stay there and gradually diffuse its lime into the water, and stay for one or two or three or four hours. After e softening has begun it will be continually contaminati wa-ter; therefore the outflow pipe is advantageousl fact necessarily placed at the bottom if there is going soft water, and that is the feature of the invention that is recited in Claim 5."

I do not see the need of harmonizing the quotation with the answers I have given in this litigation. They are entirely in harmony.

151

Wednesday, October 30, 1929,
Two o'clock p. m.

HOWARD L. TIGER, recalled, testified as follows:

Direct Examination by Mr. Cooper.

I know what calcium sulphate is, it commonly occurs in nature in the form of gypsum. It is a substance which is encountered in hard waters that we have to treat. We find natural waters having a sulphate content of ten grains, twenty grains, thirty grains hardness per gallon. By that I mean sulphate hardness. We used it in the Brooklyn tests because we had the Brooklyn city water available and that, of course, only contains one to two grains of hardness and it is consequently not a hard enough water to make a representative zeolite softening test, so we artificially hardened the water. Now, when it came to artificially hardening that water we had the choice of using various compounds to add that hardness to the water. The natural thing was to choose such compounds of hardness as sulphates, chlorides or bibarbonates. Now, bicarbonates of calcium and magnesium are not available as such. Therefore we did not take the bicarbonates. If we had taken chlorides these chlorides, that is, hardness chlorides, would have increased the chloride content of the water to a considerable extent and would have made it more difficult to see the difference in chlorides which we were going to look for in the tests. That left us only to take the hardness compounds which were sulphates
152 and therefore we took sulphates.

The use of calcium sulphate in the quantities used in the Brooklyn tests has no substantial effect upon the subsequent soap test to which we subjected the water.

In the ordinary course of my business with the plaintiff, I have had occasion to determine in connection with the design of its commercial output, the relation between the expansion of the bed of zeolites and the rate of back wash. I can express it orally and by a curve. If you pass the water upwardly through a zeolite bed, the bed becomes expanded appreciably when the rate of flow upward corresponds to about two to two an done-half gallons of water per square foot of area per minute. And it continues to expand more and more as that rate is increased. Now, when you get to a

rate of about four gallons per square foot per minute that expansion is about five to ten per cent of the bed. And when you get to a rate of about six gallons per square foot per minute, that expansion amounts to about twenty to twenty-five per cent of the bed, and in stating these expansion figures I refer in my expansions always to the original volume of the bed before starting the wash.

Cross-Examination by Mr. Byron.

Waters occur occasionally in nature which contain as the main constituent calcium sulphate, that is, the hardening constituent. I would say that waters containing calcium sulphate occur occasionally, but not very much; but waters high in sulphate hardness, that is, sulphates of calcium and magnesium, occur more frequently.

153 Now, in those Brooklyn tests by plaintiff of defendant's device, you say it was not a question of hardening or exhausting the bed, but in making any test of a zeolite softener we always consider the capacity of that softener for softening water and a test run means to me a run carried out from the time you begin to get your soft water until you no longer get soft water.

Plaintiff's object in running tests on defendant's upflow softener in Brooklyn was to determine whether or not there was a salt solution left in the lower part of the casing after the down rinsing operation, under the usual commercial conditions.

I don't think we can say the bed could have been hardened by any hardening water and still reach the results that plaintiff was after in the tests on the chloride contents, for this reason, for example, if you took a water containing we will say about 200 parts per million of chloride hardness and assume that water after softening would contain 210 parts per million of sodium chloride. Now, to measure the difference between 200 parts per million of sodium chloride and 210 parts per million is more difficult than to measure the difference between 10 parts and 20 parts per million, although the difference is the same in each case, that is the difference between the chloride before and after is the same in each case.

The hardening elemnt in th Brooklyn city water, as always is the salts of calcium and magnesium. The use of Brooklyn city water would not have confused plaintiff's test of defendant's upflow softener at Brooklyn so far as chlorides

are concerned. I don't think there was any peculiar reason why plaintiff wished to use calcium sulphate. The
154 hardness of Brooklyn city water runs between one and two grains per gallon. The total hardness in the water used for hardening the bed and rinsing the bed by plaintiff, of defendant's softener was 18 grains hardness, according to the stipulation.

The difference between 18 grains and two grains or one and one-half grains, as the case may be, represents the difference, 16 grains of calcium sulphate.

I said that sodium sulphate does not have a substantial effect on the soap test, but I deny that I said that calcium sulphate has no substantial effect upon the soap test. The calcium sulphate is used and passes through the zeolite bed and therefore it is changed into sodium sulphate. I said that sodium sulphate in the amounts that it would be present in that water after softening had no substantial effect on a soap test. The calcium given up by the calcium sulphate would balance the sodium which is taken off by the sulphate going through the bed.

I would say there is not an overwhelming amount of sodium sulphate in the water after it has passed through the bed on rinsing. Eighteen grains of sodium sulphate in a softened water is not an abnormally high amount.

I stated that that sodium sulphate will not have a substantial effect upon the reaction of standard soap solution; it would not have a substantial effect, and that was based on my experience in the treatment of such water and the operation of zeolite softeners. I will explain why it has no substantial effect; when we test water for hardness we
155 add to the water a soap and we shake the water with the soap. In other words, we measure the soap consuming power of the water. Now, as we add soaps to the water, these soaps re-act with the hardness in the water, that is, with the calcium and magnesium salts to form insoluble products, insoluble soaps. For example, if we consider a soap to be sodium stearate and we add that to water containing hardness, the soap is consumed in the reaction and the product formed is calcium and magnesium stearate, which is insoluble. Now, we have to continue adding soap until we have consumed all the hardness present in that water. Then the soap that is further added to the water can produce a lather upon shaking. Now, sodium sulphate is itself a sodium salt. Sodium salts do not form insoluble soaps and therein lies the secret of the utility of zeolite softened wa-

ters for processes which use soap. That's why after you soften the water by zeolites and you take out the calcium and magnesium salts and you have sodium salts, these sodium salts do not influence that water where you have to use soap. In other words, you now have a water which contains a corresponding amount of sodium salts, but the sodium salts do not consume the soap that you use and the soap is free to produce a lather.

The sulphate is the radical which is combined with the sodium. The acid radical does not combine with the soap, it is the sodium or the calcium, the so-called metallic radical of a compound which would react with the soap if it could react, and therefore what I mean to say is that there is no appreciable reaction I know of between the sodium salts and soaps.

156 It may be true that sodium chloride is frequently used to salt out soap in its manufacture, but there it would be used in quantities which are probably very large compared to those we are talking about. I am not familiar with the system of manufacture of soap. I therefore can not pass upon the question as to whether or not sodium sulphate can be used or if it could be used, what quantities would be required.

Q. There was a point that came up yesterday while you were on the stand that I was mislead by and I am afraid the court was also, and I think we should be straightened out on it. You were referring to the profit of this plaintiff company as being two and three-quarter millions or three millions of dollars.

A. That's the total, not the profit.

The Court: I understand.

Mr. Byron: What was it?

The Court: The volume.

Mr. Byron: All right.

Q. The volume of business, is that it?

A. That's correct, yes.

Q. And that's the total volume of business for the whole company?

A. For the Permutit Company, yes, sir.

Q. Yes. Now, I was led to believe that the only business that the Permutit Company had was the manufacture of zeolites and the manufacture of tanks in which the zeolites were used. Now, I want you to tell me what other lines the Permutit Company manufactures.

157 The Witness: (Continuing) We also manufacture auxiliary equipment that is used in connection with zeolite softeners. For example, if you have a dirty water and want to soften it by zeolite we have to filter it before we soften it. In that case we would sell the zeolite softener with a filter. Another example I might give you is, if we were going to treat a water of a certain volume for certain purposes, for example, suppose we were going to treat a water very high in bicarbonate hardness to be used we will say in boiler feeding. If it happens to be a large installation it is desirable to reduce the soluble salts in the final effluent to as great an extent as possible. That can best be done by treating the water before it goes into the zeolite softener by means of a lime treatment and then finishing the treatment with zeolites. We call such a plant a lime zeolite combination softener and we have such plants in operation and manufacturing them.

It happens occasionally that we sell lime water softener equipment even in places where we do not sell the zeolite in connection with it.

Mr. Byron: As a matter of fact, there are hundreds and thousands of installations in the country of lime softener equipment, all over the country?

Mr. Cooper: Of the plaintiff, do you mean?

Mr. Byron: All.

A. There are.

158 The Witness: (Continuing) We manufacture also a CO_2 recording and indicating instrument for use in combustion work, and that amounts to a very small proportion of our total business. We also manufacture a continuous blow-off system used in connection with zeolite a system for boiler plants. Those are all the products I think of right now. We do occasionally have a call for a manganese removal system, perhaps one in five years, or something like that.

Whereupon the defendant, to maintain the issues on its behalf introduced the following evidence:—

DEFENDANT'S EXHIBITS NOS. 20 to 62 offered and marked in evidence.

159 DOUGLAS V. MOSES, being first duly sworn on behalf of defendant, testified as follows:

Direct Examination by Mr. Byron.

My name is Douglas V. Moses, I am 34 years old. My residence is 4406 Barring Avenue, East Chicago, Indiana. I am by profession a chemical engineer in charge of technical work at the Graver Corporation, the defendant. I never have testified in any suit before.

The Witness: (Continuing) I attended Iowa State College, receiving the degree of Bachelor of Science in 1919, the degree of Master of Science in 1921, and the degree of Doctor of Philosophy in 1925, all degrees with a major in chemical engineering. For the eight months immediately following my Bachelor of Science Degree I was employed by the Engineering Experimental Station at Iowa State College as assistant chemical engineer, and that would take up to the beginning of 1920. From 1920 to 1925, including the school year, I was instructor in chemical engineering at Iowa State College. In the summers of 1923 and 1924 I was employed by the United States Bureau of Public Roads stationed at Iowa State College.

160 I have been employed by the Graver Corporation since August 1925. During the first portion of my employment, I worked in connection with the preparation of zeolite, very shortly after that on the solving of various problems connected with water softening and research, now on elaboration of the same duties, together with the recommendation of the various treatments for water softening purposes.

My work had been of a practical nature in and out of the factory and in and out of plants and examination of zeolite water softening plants, the designing, construction, and so forth, very general.

As a result of my education and experience, I feel qualified to design, construct, operate and generally give consulting advice for water softeners and particularly the zeolite type of water softener. In my opinion there is no great problem or difficulty in the softening of water by the zeolite process, regeneration of exhausted zeolites, and the washing out of the salt from a bed of zeolite. In my opinion up-flow softening is preferable. My reason, first, the lower pressure flow of the up-flow machine. In the down-flow machine the bed of zeolite offers a considerable resistance to the passage

of water and causes a pressure load during the time that the water is passing through the zeolite bed. In the up-flow machine with the bed in suspension or semi-suspension, as
161 it may be, the pressure load is, of course, practically missing, such pressure load as is the result of the water passing through the bed is practically missing. In addition there is with the softener operating a lack of channeling a greater surface contact with the mineral. Obviously, the mineral practically lifted and floating around in water, is washed on all sides by the water and for that reason we usually get a higher efficiency from the same mineral in an up-flow machine as compared with down-flow machine.

There is also an advantage in the saving of the back wash water necessary in the operation of a down-flow machine. The bed of zeolite is continuously back-washed throughout the softening run and it is not necessary to back-wash before regeneration.

In regard to saving of auxiliary equipment in the use of up-flow softeners, as distinguished from down-flow affecting pressures; in many cases where it is necessary to elevate water to a considerable height in a building or possibly in a hotel, something of that sort, if a down-flow softener is put in it will be necessary to install an auxiliary booster pump to boost the water through the bed and up to the top of the hotel. This is due to the higher resistance of the zeolite bed.

The real test as to whether there is channeling in a zeolite bed is whether or not the softener makes the rated capacity.

I have read the Gans patent in suit. I understand what it discloses. No provision for beck-washing, and no provision for disposing of the slime is described and illustrated in the Gans patent in suit.

162 Referring now to the drawing in the Gans patent and mentioning that the pipe *j* connected to the lowest part of the casing is branched, part of it going to the sewer and part to the soft water line, there is no means disclosed in the drawing or in the patent showing a connection for forcing wash water or back-wash water up through the bed.

There is no pipe connection or any other connection between the top of the zeolite bed and the screen *c* thereabove for disposing of dirt and slime which has collected in or on the zeolite bed during that work. There is no connection above the sand filter for disposing of the dirt and slime which may be forced, upwardly through the sand filter.The only outlets communicating with the outside of the casing is

the pipe *m*, which is described as a supply line and the pipe *l* which is described as a brine supply line.

So far as I can see the Gans device has no means whatsoever of forcing out the dirt and slime which may collect on top or in the zeolite bed; there are no such means. If the dirt and slime could not be forced out of the bed it would gradually become fouled and inoperative, due to the insulation of the particles from the water flowing through it.

I have found no such reference in the Gans patent to anything about the grade of the zeolites performing a higher resistance layer at the top of the bed. If such a fine, high resistance layer were formed on the top of the bed, it
163 would have no control over the distribution of water entering the bottom of the zeolite softener and flowing upwardly through the bed because it would only encounter the water as it left the zeolite bed.

I find no statement in the Gans patent, in the specification or claims about an unconfined bed. The Gans patent does not state what the source of the regenerating brine is. It does not state how much brine should be used; nor what degree of saturation the brine should be.

I find no reference in the Gans patent to any instruction as to the rapidity with which the salt solution should be introduced or caused to pass through or to react upon the zeolite contained in the casing.

Referring to plaintiff's Exhibit 16, which illustrates diagrammatically defendant's up-flow 1927 softener, the zeolite bed in the up-flow softener does not act under those conditions of normal operation as a filter to mechanically collect suspended matter as the water flows upwardly through the zeolite bed, because the zeolite is in a suspended or semi-suspended, at least we may say in a separated state and the material turbid in the water will pass directly through.

On extremely low flow rates, an abnormal condition, the bed acts as a filter. Assuming you are talking of our green sand softener, at a one-gallon per square foot area rate as compared with the four or five or six gallon at which we normally operate these machines, at a one-gallon rate naturally the zeolites will not be separated, and it will be pos-
164 sible for them to retain some of the turbidity on their lower extremity as they lie on the gravel bed. If the flow rate should be increased say from one to the regular flow rate of five or six the turbidity, the dirt and slime, will pass on through. They will go into the salt water line, if any is collected there. I might also mention that we do not recom-

mend the use of machines under those conditions. That is an abnormal condition whenever it occurs.

If the defendant were to supply an up-flow water softener to a customer and turbid matter or mud or dirty water was to be used, we always recommend the use of a filter. A zeolite softener is not supposed to be a filter. It is not supposed to operate on a highly turbid water. The function of a zeolite softener is solely one of softening. If there is any turbidity or dirt or slime in the water to be softened, it should be filtered out before it ever gets to the softener. It is ordinarily done where there is dirty and slimy water.

There is no back-washing in defendant's up-flow softener before regeneration, because the bed has been subject to up-flow with the consequent lifting and loosening all during the softening run. The salt solution is introduced into the zeolite bed for regeneration in defendant's structure through the upper piping, the ejector.

Referring to Fig. 2 of Plaintiff's Exhibit 16, the regenerating solution is introduced through the brine tank, through the ejector *o* and pipe 22, through valve—up through
165 pipe *b*, in through pipe 9 into the top of the machine, and spread upon the top of the zeolite bed. The salt solution naturally gravitate to the bottom of the casing fairly rapidly. Describing the action of the down-rinsing upon the salt solution so introduced, as referred to in Fig. 3, Plaintiff's Exhibit 16, the hard water is introduced through pipe 11, passes up through valve *o*, through pipe 7, 8 and 9, out into the top of the softener, follows the salt solution down through the zeolite bed here into pipe 10 and out through pipe 18 on to the sewer. That is, the salt, a portion of it, is forced out through pipe 18 and 17 to the sewer.

Down-rinsing continues in Defendant's up-flow softener until the salt taste becomes faint, or without bitterness.

Calcium and magnesium salts are characterized by their extremely violent bitterness as compared to the same quantity of sodium salts dissolved in a solution.

After the down-rinsing, the remainder of the salt solution which is not ejected from the casing, is forced upward through the zeolite bed in a manner, referring to Plaintiff's Exhibit 16, that water is introduced through pipe 11, down through pipe 10, into the bottom of the machine, forcing the remaining salt solution upward through the zeolite bed, through both pipe 9, pipe 8, through valve *o*, out through pipe 17 and to the sewer. This operation is continued until the water tests soft.

166 Up-rinsing in defendant's up-flow softener removes or displaces the hard water in the portion of the shell above the zeolite bed. This hard water is of course there due to its having been introduced into the casing during the down-rinsing. I refer to this portion of the casing lying above the zeolite bed filled with hard water. By the rinsing the up-washing operation shown in Fig. 4 of Plaintiff's Exhibit 16, the hard water is displaced and washed to the sewer, at the same time the salt solution is forced upward through the zeolite bed and regenerates that portion of the zeolite bed which has been exhausted due to the passage of hard water down through it during the down-rinsing operation.

The salt solution for regenerating the upper hardened layer of the zeolite bed comes from this space under the plate. It comes in the salt in the zeolite bed. All of the salt remaining in the casing is forced back up through there. There is a sodium salt solution left in the bottom of defendant's softener after the down-rinsing operation. A dilute sodium salt solution in the bottom of the casing being forced upwardly through the zeolite bed would have a regenerative effect upon the layer of hard zeolite at the top of the zeolite bed. My position is that up-rinsing in Defendant's up-flow softener performs a vital function.

Any salt solution will have a regenerative value on an exhausted zeolite, and that is the kind of zeolite that I am operating in the upper layer of defendant's up-flow softener. I have prepared a curve which will show the regenerative effect of dilute sodium salts.

167 I must ask the Court's indulgence for one thing which I did in expressing the concentration of the salt solution in grains per gallon. I regret that I did not express it in concentration in chloride as parts per million, as is given in the stipulation. I will be glad, however, to supply the concentrations as I have figured them out in the last few minutes.

It will show whether there is a regenerative effect. Referring to the curve, you will note that calcium hardness was replaced even down to a very low figure of three grains per gallon of sodium chloride; that three grains per gallon of sodium chloride is equivalent to about thirty-five parts per million of chloride radical. Three grains is equivalent, three grains of sodium chloride are equivalent to approximately thirty-five parts per million of chloride radical. So I have tested and show here the results obtained by regenerating an exhausted zeolite down to a low figure. Sodium

salt solution more dilute than three grains will have a regenerating value in proportion to their concentration. I have run to a lower figure since these were made and still obtained regeneration.

According to theory it would never be possible forcibly to eject all of the salt solution out of the defendant's up-flow by passing the rinse water down through the zeolite bed, referring now to plaintiff's exhibit 16, because of the fact that this is a dilution process and a dilution process follows the law that we learned at college of variable approach,
168 it gets less and less and less but it never quite ends there, and from a practical standpoint it would require an enormous volume of water to get it down even, but we would make an experimental error and think we had it all out.

Mr. Bryon: Well, if you should rinse downwardly until you got out substantially all of the salt solution, if that is possible, what would be the effect of the rinse water in so far as wastage is concerned and in so far as its hardeing effect upon the upper layer of zeolites?

The Witness: In passing the water down through the zeolites, you would exhaust a considerable portion of the zeolites due to the fact that the machine would be giving hard water—I am sorry; soft water.

Mr. Byron: And would there be a wastage of water or not?

The Witness: Very large wastage of water and wastage of capacity.

(Blue print showing the curve referred to by the witness marked as defendant's exhibit 64.)

The Witness: (Continuing) Then whether or not from a practical point of view most of the salt solution could be washed out of the bottom of the casing, it would not be practical. The standard commercial test for determining zero hardness of water is add five drops of standard B & B soap solution to forty cubic centimeters of the water to be tested and shake the container.. If a satisfactory, lasting lather, which will persist for from one to two minutes, results, the water is said to be of zero hardness.

169 Water standing that test and showing it to be commercially soft, very often contains a sodium chloride or a chloride salt reaction. That water containing the salt solution would be passed out through this soft water service line. Ordinarily it will not do any harm. In a very few cases where they are using it on high pressure boilers and

things like that, they wish to waste this water in order to cut this concentration down of salt.

Q. Do you see in the defendant's softener, as illustrated in plaintiff's exhibit 16, means connected to the lowest point of the casing for withdrawing the salt solution so introduced?

A. I see no such means.

Mr. Cooper: I think that is a waste of time.

The Court: I think so too. Objection sustained.

The Witness: (Continuing) The final quantity of salt in the Graver up-flow softener, as shown in plaintiff's exhibit 16, is washed upwardly through the bed then to the top of the casing, I am referring now to the up-flow concentration salt.

Referring to the stipulation relating to the first test of the Graver up-flow softener by plaintiff. I is stipulated with respect to defendant's tests that 1430 gallons of raw water at the rate of 57.2 gallons per minute were used in the down-rinsing through defendant's zeolite bed, this is an excessive amount to use in the down-rinse.

It is also stipulated that at the end of the twenty-five minute down-rinsing operation the salinity of the water at the outlet pipe was 17 p.p.m. of chloride content expressed
170 by the chloride radical CL. The water containing sodium chloride equivalent to 17 p.p.m. of chloride will have regenerative value on exhausted zeolites.

It is further stipulated with respect to this test that after waiting another fifteen minutes, making a one hounr interval after the close of the downward rinse or twenty-five minutes, an upflow rinse was made, and that 740 additional gallons, at the rate of 74 gallons per minute, were passed through the casing. The total rinse water thus used was therefore 2170 gallons. Such amount of rinsing water used indicates a wates of water and we do not use any such quantity of water in commercial regeneration in defendant's upflow softener. I cannot speak for others.

Approximately 1250 gallons of rinse water are normally used down and up, the total in the normal operation of defendant's upflow water softeners, used by plaintiff in its test at Brooklyn. I distinguish from 2170 gallons.

Mr. Byron: It is also stipulated with respect to said plaintiff's test of defendant's upflow softener on March 27, 1929, that there was used for exhausting the zeolite bed, Brooklyn city water, of about two grains per U. S. gallon in hardness, artificially hardened by the addition of calcium sul-

phate to the extent of 312 p.p.m., or 18.2 grains per U. S. Gallon. Please state whether or not there was anything peculiar in plaintiff's use of calcium sulphate for artificially hardening the water used for rinsing the zeolite bed of defendant's upflow softener.

171 The Witness: Well, it was my impression that the point in question was the removal of the salt solution from the bottom of the casing, and I see no reason for not using the Brooklyn city water as it is encountered for this part of the test. It is not common to find water in which the major portion of the calcium sulphate, all the hardness exists in the form of calcium sulphate. It may be termed uncommon to find such a water.

Mr. Byron: State what effect, if any, sodium sulphate resulting from the action of the zeolite on the calcium sulphate has with respect to the standard B & B soap test.

The Witness: The sodium sulphate has a delaying action or slight interference with the formation of a lather on the water and would consequently cause the washing operation to go a little further, but it would indicate soft water by this test.

Mr. Byron: Is it only slight or what?

Mr. Cooper: Well, he said it was slight.

Mr. Byron: Well, now, I am asking him if it only slight.

Mr. Cooper: I object to your cross-examining your witness.

The Court: Yes; slight is a comparative term. You may explain what you mean by it, at least make an effort to do so. You mean by that it is comparatively slight?

The Witness: Your Honor, I do not like to go into the definition of words.

Mr. Byron: Well, it will have some effect.

A. It will have some effect; that is right.

Q. May I put it this way: Does it have an appreciable effect?

172 A. It has an appreciable effect.

The Witness: (Continuing) In the ordinary commercial test five drops B & B soap are placed in the testing bottle containing the sample, all at once, and the sample is shaken. Plaintiff in conducting the test in question on defendant's device only added five drops all at once after their attention had been called to the fact that that was the usual method of determining whether water was zero hardness or not zero hardness. Plaintiff before that was adding two

drops, then adding one drop more and shaking between each additional and then adding another drop and shaking.

Mr. Byron: Do you know of any reason why plaintiff first used two and then two more and one, instead of five all at once?

The Witness: Well, it is a peculiar fact that successive additions of soap to a sample of zero hard water do not produce the same result as an addition made all at one time. That is, by adding five drops of B & B soap solution to many samples of zero water one at a time, you will not obtain a lather, a satisfactory lather. By adding all of them at one time you will obtain a satisfactory lather.

Mr. Byron: Then please state whether or not the addition of one or two drops at a time would give a deceptive conclusion in so far as the standard test is concerned.

The Witness: It would be necessary to produce softer water in order to satisfy—to produce a satisfactory
173 lather when five drops were added one at a time than it would if the five drops were all added at one time.

Mr. Byron: When the plaintiff was taking full advantage of all advantages to be had under those circumstances, was it not?

Mr. Cooper: I think I will object to that.

The Court: Sustained.

Mr. Byron: Q. By plaintiff adding drops of standard B & B soap solution, plaintiff found that soft water was being drawn from the waste pipe at the end of eighteen minutes during down-rinsing, at which time there were 85 p.p.m. of cloride as expressed by the chlorine radical Cl. The stipulation also shows that by properly applying the normal standard 5 drop test, that soft water was found at the end of 15 minutes of down-rinsing, when there were 220 p.p.m. of chlorine expressed by the chloride radical Cl. Does such difference in the application of the test show a marked difference in results?

A. Shows a difference in the result in the amount of salt removed before soft water is produced downward.

The Witness: (Continuing) The defendant in the operation of its softener would stop the down-rinse and start the up-rinse at the time the taste of the effluent water—at the time the effluent water has a slight salty taste or one without bitterness.

174 Somewhere between 6000 and 18000 p.p.m. of chloride, ordinarily, would normally be in the water in the bottom of the casing at the time the down-rinse is stopped

and the up-rinse is started in accordance with defendant's method of operating defendant's softener. The reason the defendant has for starting the up-rinse so much earlier is in order to obtain the regenerative effect of the brine on the exhausted upper layer by forcing or backing up there and in order to save water which would be wasted in time to force all of this brine solution out.

Q. I do not wish to raise an unpleasant subject, but I would like to have you tell the court where you found the ribbon of paraffine in question when you put your arm through the opening.

Mr. Cooper: Surely. It won't be an unpleasant subject. I would like to have the thing cleared out.

The Witness: May I indicate on the drawing?

Mr. Byron: Yes, indeed.

The Witness: It is much easier than to try to describe it. Referring to plaintiff's exhibit 16. I found—I wonder if it would not be plainer if I would indicate on the drawing itself the drawing of the machine used in the test.

Mr. Byron: Yes. Indicated on the diagram.

175 A. The court understands there was a flange on the bottom of the machine tested.

The Court: I understand the construction.

A. It was possible to put one's arm up through there. I put my arm up through there to that flange on the back of the flange, and found the paraffine outside of these notches, outside of the ring, and forced it through the notch and took it back out of the bottom.

The Witness: (Continuing) With respect to the second test that plaintiff made in Brooklyn, after the down-rinsing stopped, was completed, and samples taken, it was shown that the bed was upwardly rinsed for eleven minutes and that 641 gallons were used during the up-rinse, at an average rate of 58.3 gallons per minute. In this test a total gallonage including the down-gallonage of 765, amounted to 1406 gallons; it is slightly excessive. As I said before, about 1250 gallons are normally required for the operation of this size of equipment.

The conclusions I have to make, with respect to the result of the second test which plaintiff made on defendant's up-flow softener which was conducted on May 15, 1929 is that there was salt solution in the bottom and it was forced back up through the zeolite bed.

176 I have read and understand the disclosure of the Technische Rundschau Article of January 27, 1909, defendant's exhibits 24 and 25. In my opinion an apparatus as disclosed by said Technische Rundschau Article could produce zero hardness water in a practical and commercial manner in the ordinary use of the apparatus. It would regenerate the zeolites in a practical and commercial manner. An apparatus as disclosed by said Technische Rundschau Article could operate generally in a practicaly and commercial manner to produce good practical results in ordinary use. I base my answer upon the operation of such a softener
177 installed in the Hawthorne Service Laundry, at Hawthorne, New Jersey. I refer to the water softener apparatus here in court known as defendant's exhibit 19.

Mr. Byron: Just a statement at this time at the suggestion of opposing counsel.

After the apparatus was brought back from the laundry at Hawthorne, New Jersey, portions of the casing were cut out to make it convenient for one to see the interior arrangement.

The Court: I see.

The Witness: (Continuing) I issued the necessary order for the production of the water softener built in accordance with the disclosure of the Rundschau Article and known as defendant's exhibit 19, I indicated the type of equipment to our engineering department and traced it through our production department. I had a drawing made. I refer to a drawing numbered SW 718 and marked as defendants's exhibit 40, this is a blue print of the drawing. You will find it attached to exhibit 40.

I used as a basis of this drawing the illustration contained in the Technische Rundschau Article, defendant's exhibit No. 24.

The Court: For my information, did that article go to the Court of Appeals?

Mr. Byron: The Rundschau Article itself?

The Court: Yes.

Mr. Byron: The Rundschau article did, but no physical device.

178 The Court: The article itself went?

Mr. Byron: Oh, yes.

The Court: And what is that other one?

Mr. Byron: The Feldhoff or the Leister?

The Court: No, the German translation.

Mr. Byron: Yes, that is all before the court, but apparently the court never paid any attention to this article.

The Court: I see no mention of it at all.

Mr. Byron: I don't think any of the judges did, with the exception of the Court of Appeals of the Second Circuit in discussing whether it shown an upflow softener. I am speaking of the Runschau article.

Mr. Cooper: I think this was also before the Sixth Circuit Court of Appeals.

Mr. Byron: I am explaining it was before the Court of Appeals, but your patent expert says it was ignored by that court, it was not considered.

Mr. Cooper: Well, you are putting a different implication on it now from what I see.

Mr. Byron: I am just saying what the expert said.

Mr. Cooper: Yes; that is quite right.

The Witness: (Continuing) The water softener, defendant's exhibit No. 19, was built in the defendant's plant at East Chicago, Indiana. It was finished on March 12, 1929. So far as I could, I followed accurately the disclosure of the Runschau Article in building the softener itself, defend-
179 ant's exhibit 19. I had no difficulty whatever in following the disclosure in building the device. Of course, I wish to explain that the device has a diameter of 48 inches and the dimensions of 2.4 meters in the Rundschau article calls for 47.4. We naturally could not obtain a tank having a diameter of 47.4.

The Court: That would be immaterial if you are only off an inch and a half in size.

Mr. Cooper: No; we will raise no point on that.

Mr. Byron: Q. So that you feel that in building this Rundschau softener, defendant's exhibit 19, you have made a perfectly honest effort and have made a true duplication from the disclosure?

Mr. Cooper: I think I will object to the form of the question. The witness has already stated what he thought and his honesty is not in question at the present time and I do not think counsel can cross-examine him.

The Court: You may answer it.

A. I followed it as religiously as I could.

The Court: All it amounts to is he said he did so to the best of his ability.

The Witness (Continuing): After this device was built it was shipped to the American Zeolite Company, of Patter-

son, New Jersey, and installed under the supervision of Dr. Riley in the Hawthorne Service Laundry, at Hawthorne, New Jersey.

180 Dr. Riley's full name is, Dr. Ray Riley. He had charge of the installation of the Rundschau device at the Hawthorne Service Laundry; it was installed at said Hawthorne Service Laundry sometime in April.

A zeolite called Decalso, manufactured by the American Zeolite Corporation was placed within the casing of said Runschau device, defendant's exhibit 19.

Q. How long has said Rundschau device been in operation at said Hawthorne Service Laundry?

Mr. Cooper: I think we are getting on to what is probably hearsay with this witness. He said that Dr. Riley had it in charge and it is no use to ask the witness.

The Court: Supposing this witness tells what he knows.

Mr. Byron: I will qualify the witness. I was trying to save time.

Mr. Cooper: Very well.

The Witness (Continuing): I have visited this laundry at Hawthorne. I saw it on May 14th, 1929. That was the first time I saw it after it was installed. I saw it once at the American Zeolite plant before it was installed. I visited the Hawthorne Laundry, as I have stated, on May 14th, again on June 22nd, again September 9th, 10th, 11th, 12th, and 18th.

There has been a log prepared of this Rundschau apparatus from the time that it was installed at the Hawthorne Service Laundry, it was prepared by Dr. Riley. I notice on page

181 3 thereof that "Mr. Byron, patent attorney, and Dr. Moses, of the Graver Corporation, looked over the installation on May 14th." Then there is another notation that on May 19th the Rundschau apparatus was opened. "The excelsior seemed to have an odor and Dr. Moses suggested painting the excelsior with an asphalt paint, but the suggestion was never followed out."

The log is very slightly inaccurate on one particular point, and that is on May 14th—it is not inaccurate; it just does not state that on May 14th I visited the machine in the forenoon and afernoon both. In the forenoon I looked under the upper perforated plate at the excelsior. On May 19th, or approximately at that time, I was written by Dr. Riley, a letter was written to me by Dr. Riley in which he said that it seemed that there was an odor that some people thought there was an odor to the excelsior. Well, I had not been able

to detect any odor at the time of my visit and I said that I was open-minded on the subject, I didn't know whether the excelsior would rot in there or wheher it would not, and if it did rot we would take that charge out and throw it away and put some black paint on some excelsior, making use of the ordinary expedient of painting a building, and put this excelsior back in the machine. It was never necessary to follow out the suggestion, because the excelsior did not decay.

I have seen the excelsior at some of these times, and I believe we have some of it now. Shown a can of what purports to tbe excelsior, I find it to be in good condition.

182 (Witness smells can of excelsior as requested) There is an odor as if it were coal tar, I don't know what that is, a rather sweet, pleasing odor. There is no smell of any decay, however.

(Can of excelsior is marked for identification as defendant's exhibit 17.)

Mr. Byron: Do you know whether or not that excelsior is the excelsior that was in the top of the casing or in the casing of the Rundschau device, defendant's exhibit 19, at the Hawthorne plant?

Mr. Cooper: I will take counsel's statement. If counsel says that is the excelsior that was there throughout, I will take his statement on that exhibit. It doesn't seem to me that Dr. Moses could possibly say as a technical matter, he not having been there all the time.

Mr. Byron: I was going to put Dr. Riley on the stand. He shipped the container.

Mr. Cooper: We had better wait for Dr. Riley then and prove the fact.

Mr. Byron: All right.

The Witness: (Continuing) I visited the Hawthorne Laundry Service in order to inspect the said Rundschau device and it was operating in a satisfactory manner at the times of my visits giving zero water.

183 Q. Was it operating to capacity?

A. By capacity do you mean the rate of flow or what?

Q. When you spoke of capacity I mean the capacity for which the machine was designed, for the character of zeolite, quantity of water being softened.

The Witness: (Continuing) I found that the machine was delivering approximately 60 gallons per minute of soft water. This is considerably in excess of the amount which the article says the machine will deliver of soft water. Such delivery is

a good commercial delivery of soft water. Compared with our softener, with the defendant's softener of the same diameter, this is a normal flow rate for it, 60 gallons per minute, of softened water. It is my understanding that that would be a rather high rate for one of plaintiff's softeners.

184 The Rundschau device, Defendant's Exhibit 19, was received at the defendant's plant about October 19th. I cannot tell you if it was the afternoon of October 18th or—I saw it, October 19th. It was shipped from the American Zeolite Corporation of Patterson, New Jersey, and is the same device as tested at the Hawthorne Laundry Service, Hawthorne, New Jersey, on Thursday, September 12, 1929.

On this device there is an additional soft water line over at this point, and that is not disclosed in the Rundschau article, I am told that additional pipe was placed there because the supply of water to a laundry has to be very rapid for certain apparatus, and it was possible to draw the water from that machine more rapidly than it was possible to draw it through that lateral system up on top of the machine, and it was for that reason, for obtaining an increased flow of water from the machine, that this connection was made. The efficiency of the machine was sufficiently high to permit a greater quantity of soft water to be drawn off. There is another addition back here, there is the soft water line connection, and then there is an additional elbow; that is a line for disposing of the waste water as the machine is rinsed upwardly immediately after the salt has been drained from the machine.

In the Rundschau device, it is probable, it is necessary to waste the water during this up rinsing operation over the side of the machine, and in the laundry for every day service we do not wish to do that, so we made the additional connection to dispose of this water to the sewer. This does not

185 in my opinion, in any way change the effect or result produced by the Rundschau device. It is entirely a matter of convenience. This Rundschau device was tested in accordance with this article of January 29, 1909.

It is noted from the stipulation that after the zeolites in this test on September 12, 1929, were regenerated, raw water was admitted to the bottom of the casing and passed upwardly through the bed of zeolites for washing said zeolites, the wash water filling and overflowing the casing, and that this washing and filling operation was continued for fifteen minutes, whereupon a test of the effluent with the standard B & B soap solution showed a good lather with three

drops of such B & B soap solution. This test showed efficient production of zero water.

I have not that time noted, but it is my remembrance that practically eight minutes was required in filling the casing; the remaining time in actual rinsing. With only a few minutes of rinsing the soft water produced by passing the hard water through the regenerated zeolites showed a better test than is commercially required.

Referring to Plaintiff's first test of Defendant's upflow softener, twenty-five minutes of downflow rinsing with the use of 1430 gallons of rinsing water was required before three drops of B & B soap solution would produce a lasting lather, whereas said test of said Rundschau softener only required
940 gallons to be used in the entire rinsing operation; it
186 indicates that the Rundschau device is more economical
of rinsing water than the defendant device as shown at those tests.

The down rinse water of 1930 gallons and the up-rinse water of 740 gallons, in plaintiff's first test of defendant's device, making a total of 2170 gallons used by plaintiff in rinsing defendant's upflow softener as against the total of 940 gallons of water used for rinsing in the Rundschau device indicates that the Rundschau device operates on a much less wastage of water than the defendant's device did in the test at Brooklyn.

The regeneration during the test of the Rundschau device was carried out by first running the salt solution from an elevated tank into the container—without going into that—I consider that the regeneration was done in a practical, in a commerical way, the same as in any other softener of today and on as good a basis.

The stipulation in regard to said test of the Rundschau device brings out the fact that during the salting operation or the regenerating operation two and a half gallon portions were drawn from the lower drain tap of said Rundschau device and dumped into the open top of the casing at intervals of ten minutes, making a total of six portions thus drawn and returned to the top of the casing; this is a very drastic test because the return of the more or less contaminated portion of the regenerating brine to the upper portion, and naturally it was necessary for this contaminated brine to pass completely through the zeolite bed in order to be drained from
187 the casing. This brine returning into the casing might
tend to displace some of the sodium in the softened bed. It would make the softener itself the thing to recirculate

brine, but that is the only one to the best of my knowledge. In the present day practice in the matter of regenerating the Rundschau device, the draining operation would be started and the salt solution admitted to the casing approximately the same rate as the casing is drained. The six hours mentioned in the Rundschau article are not necessary for regenerating the modern day zeolites. The zeolites made in 1908 or 1909 I am told required a considerable length of time to regenerate. In the practice of today it would take approximately an hour to regenerate the zeolite bed of the Rundschau device as used at the Hawthorne Laundry.

I was present after the test of the Rundschau device was completed at the Hawthorne Laundry when the upper pipes, perforated, divided plate, canvas, zeolites and gravel were removed from the casing. To the best of my knowledge all of those mentioned in behalf of plaintiff, Mr. Bakewell, Mr. Waterman, Mr. Hammer, Mr. Kriegsheim, Mr. Staegemann and Mr. Pick, were present when that was done; I saw them there.

The canvas that was withdrawn has a number of holes in it and is somewhat rusty due to its contact with the plate, but it is not rotted. That is the canvas.

(The excelsior, Defendant's Exhibit 17, the canvas, Defendant's Exhibit 16, and the rubber gasket, Defendant's Exhibit 15; a pail of the zeolites used in the device as De-
188 fendant's Exhibit 14, marked in evidence. The Hawthorne device marked in evidence as Defendant's Exhibit 19.)

The Witness: (Continuing): Referring to the date of the test when this excelsior was removed, it was tough; no evidence of decay, and I would say in good condition. That excelsior was in the casing, in actual service, from, to my knowledge, May until the 12th of September. The zeolites at the end of the test in question were in good shape. I mean by that, ready to soften water and regenerate, and to the best of my judgment to do the same through many more cycles.

Mr. Byron: I will have to avoid asking that question about the zeolites, whether or not they are the same zeolites in the casing, if you ask for corroboration.

Mr. Cooper: I am perfectly willing if you will give me your assurance.

The Witness: (Continuing) After said test there was no evidences that the zeolites were deteriorated. You will note in examination of this zeolite, that there are some grains slightly darker colored than others, but this is entirely com-

mon. The dark color is brown, and I am unable to tell you exactly why certain grains get brown and other grains lying immediately alongside do not get brown. In all decalco that I have ever seen it is true.

There was no evidence of channeling, from an examination of the zeolites. The gravel was in good condition, sharply defined in the two layers which were used.

189 In my opinion the softener disclosed in the Rundschau article, based upon my tests, is a practical up to date softener. It could be used today in practical commerce, in an efficient manner.

Mr. Byron: Is there any objection in your opinion to the use of a locked bed or a bed locked or unlocked as described in the Rundschau article and as used at the test at Hawthorne?

A. There is no objection.

The Witness: (Continuing) The function performed by the locking element or the screen element over the zeolite bed in the Rundschau device is simply to retain the zeolites from passing into the soft water outlet lines. The upper screen or locking element performs no other function that I know of offhand. There might be one, but I cannot think of one at present. If a screen is not used above the bed of zeolites for preventing the washing away of the grains, the height of the shell would be extended a little bit, and the pipes for that effluent water would be raised above the range to which the zeolite would be raised during the softening.

I understand that the machinery of an upflow softener has two choices of ways to prevent the washing away of the grains of zeolite; one the screen above the bed of zeolites, and the other the raising of the shell so that the upwashing of the water would be above the bed of zeolites. I have no evidence of a locked bed causing channeling.

190 I believe that plaintiff's expert on the stand this morning stated that a bed is locked when it cannot expand over 10 per cent in height of the height of the bed; that was my understanding on hearing that testimony.

In constructing a Rundschau device, more particularly in the installation of the zeolites in the casing and in accordance with the blue print defendant's Exhibit 40, it is noted that there was a space of four inches left between the top of the bed and the upper screen; in the intervening space of four inches excelsior was placed. It was just loosely packed in, packed in loose but firm. When excelsior is packed in a space dry, and is soaked with water, it becomes soggy and flattens

down, if subjected to any pressure at all or any weight on it or pressure against it, it will compact very much.

Mr. Byron: With what result insofar as spacing is concerned, that is free space, unconfined space, between the top of the zeolite bed and the perforated plate or screen?

The Witness: I am afraid we are a bit mixed up on that, in this way, that the space between the perforated plate and the excelsior bed—I mean the top of the zeolite bed is four inches.

Mr. Byron: Correct.

The Witness: And the excelsior after being compacted once or twice will rise up and fill perhaps half or perhaps less of that space, leaving, as it is immersed in water, a space between the excelsior and the top of the zeolite bed.

191 When they are immersed in water I mean they flow through the container, but the container fills with water.

The Witness: (Continuing) I have a definition of a locked bed, with reference to zeolite of course, a locked bed is any bed of zeolite in which a retaining means interferes with the normal expansion of the bed, under the conditions of its normal flow rate. In my opinion a Rundschau device as built and erected falls within my definition of a locked bed.

At the time of the test when the bed was being exhausted samples of water were taken from different portions of the bed, from these samples taken, there was an indication that there were different degrees of hardness in those samples.

It indicates to me simply that the top of the bed of zeolites was not level; it was being pressed up against this excelsior, and the excelsior was more or less bunchy; it was impossible —I need not say impossible, but very hard to lay excelsior so it was absolutely uniform. In some places it was bunchy, and that would cause depression in the zeolites. The bed was very nearly exhausted at the time the water was started flowing through it, and only a small amount of the upper portion of the bed was active. Now the water that came through these dip portions was harder than the water that came through the more elevated portions and had longer to travel through the zeolites. In addition the casing was not quite level; it was about an inch higher on one side than on the other. That might account for slightly deeper layer of zeolite on one side than on the other.

192 Q. But the real test of any softener with respect to this question of channeling is whether or not the softener actually softens to capacity, is that correct?

Mr. Cooper: I would like to have the witness testify, and not counsel.

Mr. Byron: Q. Please state what the real test is with respect to channeling, as to whether or not there is channeling?

A. The real test in respect to channeling must be the capacity obtained from the machine. It is impossible to reach inside of a full sized softener and see exactly what is happening. The only way we can gauge the machine commercially, as to whether it is channeling, is upon the capacity of the machine.

The Witness: (Continuing) In order to not have channeling in a down-flow softener, it would be necessary to have absolute uniformity throughout the zeolite bed. This condition is hardly ever if ever realized, and certain portions of the bed will pack more rapidly and more densely than other portions, and as a result areas of high resistance are formed and the water will flow more rapidly down through the areas of low resistance.

Mr. Byron: What in your opinion is a theory for using gauges on the downflow water softener?

Mr. Cooper: I will take the same objection.

193 Mr. Byron: I have a right to ask him.

The Court: Whether he knows any reason for it, he may answer if he knows any reason.

Mr. Byron: What is the reason, if you know?

The Court: If his experience is such that he knows the reason he may answer.

The Witness (Continuing): It is my understanding that the gauges are placed on a downflow softener in order to measure the differential of pressure, the difference in pressure between the water above the bed and below the bed during the time that the water is flowing through. The reason for wishing to get that differential is to prevent it from reaching too high a figure, because if the difference between those becomes too high, the machine ordinarily channels very badly.

Mr. Byron: Is the pressure on the incoming side greater than the pressure on the outgoing side, and what is your reason?

Mr. Cooper: Now, it seems to me that he has not qualified the witness as to the use of these gauges, as far as I have heard?

The Court: Do you know?

The Witness: I do.

The Court: He may answer.

The Witness: The pressure on the incoming side is greater than the pressure on the outgoing side because of the friction of the zeolite bed.

194 The Court: The friction caused by the zeolite bed.

The Witness: That is right.

The Witness (Continuing): Ordinarily five pounds is the difference in pressure which is allowed without serious channeling; if the pressure gets above five pounds; that is if the difference in pressure gets above five pounds, it will channel. An operator of a downflow softener would overcome it by back washing the softener, even though the capacity, as far as softening capacity goes, has not been reached, he will back wash the machine, in order to break up channeling. On the one downflow water softener with which I have come in contact, that is a practice which is carried out.

Mr. Byron: I wish to refer to the Duggan patent 1,276,629, Defendant's Exhibit 49, and ask you whether or not there would be in your opinion channeling as a result of the plate, perforated plate or screen 2 being down tight upon the zeolite bed, in upflow action?

Mr. Cooper: This is under my objection, your Honor. That is a patent later than the patent in suit, and it is the one that counsel has been suggesting he will connect up some way or another with the litigation.

The Court: You expect to make that connection, do you, Mr. Byron?

195 Mr. Byron: Yes, I want to show that a locked bed will operate perfectly without channelling, and that plaintiff agrees with us, atlhough they do not agree with us.

The Court: The mere fact that a man claims in his patent that it would do it, would not prove it, would it?

Mr. Byron: A man who was in the employ of plaintiff.

The Court: You are offering it as an admission of the plaintiff.

Mr. Byron: Absolutely so. This is a patent that was taken out—

The Court: But when a man secured a patent with certain representations in the application, those representations are in his own personal capacity.

Mr. Byron: Here is the assignor, Thomas R. Duggan, in New York, an assignor of the Permutit Company of Brooklyn.

The Court: Was that before or after the patent was issued?

Mr. Byron: Well, it has to be assigned before the grant of the patent or that marking would not be there.

The Court: That is what I am asking.

Mr. Cooper: I still cannot see that an assertion of an inventor in applying for a patent is an admission of interest as against his assignee that can by any possibility be effective.

196 The Court: If before the patent is granted they accept an assignment of it and adopt it as their act, before the patent is issued, they are a party to the granting of the letters patent.

Mr. Byron: Furthermore brought suit upon it.

Mr. Cooper: I haven't yet heard what the admission is.

The Court: Let it go in subject to the objection to save time.

Mr. Byron: The question is, under those circumstances with the plate 2 down tight on the zeolite bed, whether or not in your opinion in the upflow softener a bed would channel?

A. It would not channel.

The Witness: (Continuing) My reason is that if the zeolite bed is laid uniformly between the perforated plates, there is no reason for it becoming non-uniform at a later date if it cannot move around, and if there is no lack of uniformity in the bed certainly there will be no non-uniformity of resistance, and a uniform flow over it.

I have made some general tests along this line with a device of this nature with the perforated screen down tight upon the zeolite bed and directly down upon it without any intervening element whatsoever. Very satisfactory result. No evidences of low capacity, which is my measure of channeling. I consider the device as illustrated in the Duggan patent 1,276,629 a practical operative commercial device. In the description he refers to Fig. 1 as an upflow device and to Fig. 2 as a downflow device; I see no reason why both types should not operate commercially.

197 Thursday, October 31, 1929, 9:30 o'clock a.m.

Referring to the Rundschau article and to the drawing of that article, I find disclosed there means connected to the lowest point of the casing for removing the salt solution introduced into that casing. The means is a drain pipe connected to the very lowest point of the casing. That drain pipe is controlled by a valve *i*. There are openings immediately above the lower portion of the shell, openings into the main pipe. I have reference to those openings as shown immediately above the casing (indicating).

Mr. Byron: Whether or not there are openings there,

would you or would you not, as one skilled in the art, know how to drain a casing of that type?

The Witness: Well, drainage of a casing has always meant to me that you should let gravity do the work. If it was necessary to put some holes in the pipe, it would not require much imagination to put them in.

The Witness: (Continuing) I find in the Rundschau article reference to draining the casing. The following statement occurs in the Rundschau article:

"When all the water has been drained from the filter the salt solution is run through the pipe *g*, valve *f* and slotted distributing pipe *k* onto the Permutite."

That means to me complete drainage, all water.

"This is allowed to react with it for about six hours with intermittent draining through valve *i* and subsequent re-
198 turn through the filter. At the end the salt solution is drawn off and the filter washed out with water till it no longer reacts of lime and salt."

As one skilled in the art I would understand that the casing was to be completely drained. And if there were no openings there I would place an opening at the lowest point to completely drain the casing.

I have read the article in the Practical Engineer. This article, Defendant's Exhibit number 27, is substantially identical with that of the Rundschau article of January 27, 1909. Directing my attention to the following paragraph:

"The filter, when hermetically closed, can be as well inserted into a water distribution system, thus, driving the water after treatment up to a higher reservoir."

That sentence indicates that a cover may be placed over this casing and the water driven up to a higher reservoir without re-pumping. This article does not provide for complete drainage previous to the addition of the regenerating brine. I find no mention of returning the salt that was drained from the casing.

I have read and understand the Feldhoff article, Defendant's Exhibit 32 and the translation thereof, Defendant's Exhibit 33. This device could be operated practically, commercially and efficiently in the regular use to which zeolite water softeners are put. I have experimented with a device with a completely locked bed, with good results. Locked as the Feldhoff, completely locked. As one skilled in the art
199 I can build a successful operative device from the teachings of said Feldhoff article.

I have read the Gebrauchsmuster No. 313,671 and the

translation. As one skilled in the art, I could build a successful operative device from the teachings of the Gebrauchsmuster 313,671, Ex. 30 and 31.

I have read and understand the disclosures of Defendant's Exhibits 28 and 29, Gebrauchsmuster 341,512. I believe the salt softener illustrated in the Gebrauchsmuster referred to will soften water. I believe it will regulate all of the necessary connections for supplying and taking away the water as shown. A means is provided for supplying the regeneration and I am sure the apparatus would work and soften water.

Asked whether or not this zeolite bed has a perforated cover down on top of it or if it has a perforated cover spaced from it, I say, no such cover is illustrated or described. If it were necessary to back wash such a softener, I would simply take the end of the hose *g* from the connection where it entered the softener and place it down in the lower connection and turn on the water and let the water spill over the sides until by back washing was accomplished to the point I wished it to be. The apparatus is indicated in the article as a relatively light device. It is a small device. As one skilled in the art I could build a successful operative device from the teachings of Gebrauchsmuster 341,512.

Attention is now directed to the German Leister patent, Defendant's Exhibit 34 and to the translation thereof, Defendant's Exhibit 35, I have read and understand the 200 patent and the translation thereof. As one skilled in the art I could, from the teachings of said Leister patent, make a commercially successful operative zeolite type of water softener.

Mr. Byron: Has your Honor read this one?

The Court: Yes.

Mr. Byron: Your Honor's attention is now directed to the Gans article, Defendant's Exhibit 47, and to the translation thereof, Defendant's Exhibit 44.

The Court: What is the patent number or the exhibit number?

Mr. Byron: Exhibit number 44.

The Court: What is the translation?

Mr. Byron: The translation number is Exhibit 44 and the article itself is Defendant's Exhibit 47. That's attached to an affidavit.

I wish to call your attention particularly to the loose copy of a translation secured to the printed copy of translation in Defendant's Exhibit 44, to the Mason translation.

Now, if your Honor will turn to page 1004 I wish to just scan over a couple of paragraphs with you. The title is, "Technic for Water-Purification."

"Particularly appropriate are the Permutites for softening water and removing manganese or iron from water. The process, which is in question for this purpose, is in its most simple form a pure exchange process by which the
201 calcium and magnesium of of the water are taken up by the zeolites and the sodium is given off to the water."

Then there is some equasion and the next paragraph is:

"The regeneration is performed by washing off the zeolites, which have been saturated with calcium or mgnesium, with a common salt solution, by which means a sound zeolite is again produced which is able to soften new quantities of water. There are already several filters of this sort in use, some to prepare soft water for boiler feed purposes and others for laundries. The filter plant mentioned are remarkable through the simplicity of their arrangement. The softening is complete with cold water."

And then the next paragraph:

"The apparatus consists"—

And I will ask your Honor to bear in mind particularly the construction of the Gans patent.

202 The Court: I remember it.

Mr. Byron: Yes.

"The apparatus consists of an iron or wooden filter, the height of the Permutite bed is determined by the hardness of the specific water and the rapidity of filtration. The useful effect is greater the more slowly the water flows through the Permutite filter and the finer the grain of the Permutite used."

Now, the next paragraph:

"The Permutite bed lies upon fine sand which becomes coarser at the bottom. At the top it is best closed off by a sand filter placed about one-third to one-half metres above the surface of the Permutite layer. The sand filter under many conditions can be replaced by a limestone filter, for instance, when treating the water containing iron and acids. This arrangement of the upper sand or limestone filter will also prevent that by back washings, the speci-
203 fically lighter Permutites are not mechanically washed away."

I submit to you that is a complete disclosure of everything disclosed in the Gans patent. Now, the dispute with

reference to this particular translation is in one respect and one respect only, and that is the translation of the last paragraph. I read only the second sentence in that paragraph. I will now read how plaintiff's expert Haas has translated it on page 1001:

"The Permutite layer rests upon fine sand which grows coarser toward the bottom."

And now you come to the sentence where there is dispute.

"In the upward direction it is best terminated by a sand filter, which is applied to a depth of about one-third to one-half metre over the surface of the Permutite layer."

Now, the only difference is whether or not the sand filter is directly down on top of the Permutite or whether it is not. I suppose it turns on the interpretation of the German word "hohe", which I think means high.

The Court: That is what I have always understood.

Mr. Byron: And that means there is free space.

Now, referring to this same Gans article, let us take Plaintiff's translation on page 101. I wish to point out this fact, below the paragraph which I read there is an example, and that example is this:

204 "In a Berlin factory there is a plant for the softening"—

The Court: Is it necessary to read that?

Mr. Byron: No, it is not. The point is that is referring to the Rundschau device.

The Court: I have read it.

Mr. Byron: Yes, showing that Gans thought the Rundschau device was a pretty good device. Then in the paragraph marked *b* "Removal of Manganese or of Iron";

"At Clogau, for the purpose of removing manganese, 450 kilograms of calcium zeolites, which rested in an iron tank of 0.95 square metre cross-sectional area in a layer bout 0.6 feet."

Now, in that connection I merely want to call your attention to Defendant's Exhibit 60, that's the Weiss thesis, and more particularly to the drawing in the Weiss thesis. That is a small book.

The Court: Go ahead.

Mr. Cooper: This, may I say, is a publication of 1910, which is less than two years before the patent was applied for.

Mr. Byron: Oh, yes, indeed. I merely want to show that in that same article Gans was referring to the installation at the City of Clogau, an installation which this thesis

points out was in 1908, a filter, if you please, shown in drawing 2, a filter substantially identical in construction, at least, in so far as the casing is concerned, the gravel bed below the zeolite body and, if you please, a filter spaced from the
205 top of the zeolite body five-tenths of a metre. You will find that the figures in the Gans article of 450 kilograms and the dimension of 0.95 square metres are also referred to and descriptive of the Weiss thesis device.

The Witness (Continuing): I have read and understand the Gans article of April 15, 1909, and the translation thereof. As one skilled in the art I could build a successfully operative device as a result and a study or reading of that article.

The use of excelsior is old in the water softening industry, excelsior being used in soft water. It is commonly used as a filter medium in lime soda softening, used to filter the suspended material from the softened water. It is used at the present time. Defendant has used it in its lime soda softeners and is building one at the present time.

206 I call attention to Plaintiff's Exhibit 7; it illustrates one of defendant's lime soda softeners with excelsior filter. The excelsior does not rot in this filter. It becomes more or less clogged with the suspended material, as is reasonable. The period it lasts varies somewhat. Sometimes one year, sometimes it is required in six months, but ordinarily about a year.

Q. Will you please state whether or not the defendant company manufactured sand filters before it manufactured zeolite water softeners?

Mr. Cooper: I don't know that this witness is competent. He came there in 1925 and the evidence shows that the defendant put out a zeolite filter in 1923. If counsel wants to state the facts to be so and so and knows of his own knowledge, I have no objection.

Mr. Byron: I will qualify the witness if I can.

Q. Have you investigated the records, drawings, and so on, of the defendant corporation?

The Witness: I have.

Mr. Byron: If so, have you ascertained therefrom the building of sand filters prior to the time that the defendant made zeolite water softeners?

The Witness: I have.

Mr. Cooper: Of course, that's all secondary, your Honor. It is a matter of hearsay. I have said I was willing to take counsel's statement for it.

Mr. Byron: All right. Just take my statement for it, that is the fact.

207 Mr. Cooper: All right.

The Witness (Continuing): The structure of the tank connection and pipes in the zeolite water softener as manufactured by defendant is the same as the tank, pipe and connections, and so on, of defendant's sand filter. In the sand filter manufactured and marketed by defendant it did not produce in those sand filters a screen or perforated plate to lock down the sand bed. We wished to back wash the sand filter and clean out the accumulated suspended matter from the water. We wanted a free top to that particular filter and it would cost money to put that in and I see no particular advantage to it.

Mr. Cooper: I think that answers it. It is hearsay and I move to strike it.

The Court: It may stand.

Cross-Examination by Mr. Cooper.

I have read and understand the patent in suit, and the drawings I have examined and understand.

Now, Fig. 3 I understand to be a section upon the line XX of Fig. 2 looking downward.

Mr. Cooper: And the dotted circle at the extreme right of Fig. 3, do you take that to be a representation of the pipe *p* as that appears in Fig. 1?

The Court: Do you think there is any question about that?

208 Mr. Cooper: I would not suppose there would be. I wanted to get the witness' understanding to go to a further point.

The Witness: I have never previously identified it in that manner, but it might be so. I observe on Fig. 3 the point *k* as defining the pipe *k* of Fig. 1. Then there are two lateral branches in Fig. 3.

Q. Do you understand that those two lateral branches represent a horizontal extension of the pope that is valved at *n* as shown in Fig. 1?

A. I do not.

Q. All right. What do you understand those apparent branches going out from each side at the point *k* in Fig. 3 represent with respect to Fig. 1?

A. My understanding is that pipe *m* goes in one direction and pipe *n* comes in the other direction. But ordinarily it is

common to run water in from one way and take it away from the other way.

Q. But on Fig. 1 you observe that those lateral pipes are sectioned so that they both go in the same direction, don't you?

A. I really don't believe so.

Q. All right. I will pass that.

The Court: *M* and *n*?

Mr. Cooper: Yes. That is, the sections of the pipe with which *m* and *n* are associated, yes.

209 The Court: But you don't maintain that the course of the water in the two pipes would be the same?

Mr. Cooper: Oh, no, no.

The Court: That question raises some doubt in my mind.

Mr. Cooper: I am sorry.

The Court: All right.

Mr. Cooper: I may as well state what my point is there. My notion is that Fig 3 looks down this way (indicating) and shows the upper pipe *m* which would conceal the lower pipe *n* and they go out in both directions so that there is, as shown in Fig. 3, valve control in either direction, hence one of those valves of Fig. 3 could go to waste and the other to supply.

The Court: You mean the cross section of both pipes *m* and *n*?

Mr. Cooper: No, I mean that both *m* and *n* have pipes going in both directions, so that *m* could be connected either with the sewer or supply and *n* either with the sewer or supply.

The Witness (Continuing): I first saw, in the sense of giving special attention to it, a commercial zeolite water softener in the latter part of 1921 or the first part of 1922. That was while I was still at the Iowa University, well, about the time I got my Master of Science Degree. I wish to qualify that on that it was a commercial softener. I recall whose make that was; it was a Refinite. Refinite was a defendant in one of the cases, as I remember it.

Mr. Cooper: That, your Honor, was the Buffalo case.

210 The Court: Judge Hazel's case.

The Witness (Continuing): When I came with the Graver Company in 1925 I did not have knowledge of the Paige-Jones Up-Flow Softener. Oh, previous to 1927 I had seen one or two of those. I do not remember ever having met the technical men of Paige-Jones.

Mr. Byron: Your Honor, I don't know about that, it is immaterial.

The Court: Well, he may answer.

The Witness (Continuing): I simply cannot remember exactly the time I met those gentlemen.

In 1927 I was termed the chemical engineer with the defendant corporation. I was research engineer on certain portions of the water-softening equipment. I had substantially the same capacity I have now with it; with less responsibility. I do not believe it went back as far as January 1, 1927. It was in that vicinity, though.

I think I said I had never before my appearance here on the stand given testimony in any court. I filed affidavits in the preliminary hearing on this same controversy. But I meant direct testimony. I distinguish between an affidavit and testimony.

I have found no great problem or difficulty with softening water commercially by zeolites. In general that is the substance of what I said.

Q. And that has been true from the time that you first had under consideration or examination this device made by the Buffalo concern back in 1921, as you have testified?

211 A. I never had any great difficulty in getting soft water.

Q. Well, you say you found no problem about it from that time on, is that the statement?

A. I found no problem about it, but I would not say there were not problems connected with it.

Q. You did not find them as problems, is that what you mean? Is that what you mean, you found them solved?

A. No, indeed. There are problems to everything. I did not mean to infer anything like that.

The Witness (Continuing): Considering the two demonstrations at Brooklyn, New York. There was a first one which I attended and then after an interval a second one was arranged. And in connection with that second one, and before it took place, I saw a letter written by your firm to the defendant's counsel which is attached to the second stipulation here. I now produce a copy of the document. I was with Mr. Byron when that letter was received. I cannot say exactly who prepared the reply of May 15th. Mr. Byron and I talked it over. I was consulted.

I do not recall that on the occasion of the first test I made some comment as to the degree to which the salt water had been washed out of the container, on the occasion of the first

test in Brooklyn. I can not say anything about my side, but I do not recall it came from me. I don't remember making that remark concerning the amount of salt removed. There may have been talk between those present on the first
212 occasion as to the degree of exhaustion of the salt which had been carried on during that first demonstration. I don't recall that there was.

Q. Did I understand aright that on your direct examination you said that defendant stops its down-rinsing and starts up-rinsing at the time the effluent has a slight salt taste, or one without bitterness, and that at that time about 6,000 to 18,000 parts per million of salt were in the brine?

A. In the first part of your question you stated a slight salt taste. I said faint, I believe.

Q. What I was driving at was the parts per million that you put as the basis. Did you put it six to eighteen thousand?

A. That is right.

Q. Now, in this letter of May 15th by Mr. Byron to my firm, nothing more was said about the degree to which it should be carried in order to get this salt taste becoming faint except that the figure of 500 to 600 parts per million, which was referred to in the last paragraph of our letter, may be inaccurate. Could not you at that time have given the same figures you have given here?

A. Had I been asked for them.

Q. Didn't you understand that that was the point of inquiry, to know to what degree the saltiness should be produced?

213 A. I certaintly did not understand it. The letter says that they were going to run it, that the plaintiff was going to run the test at 500 to 600 parts per million chloride and if they wished to run it at that,—I did not know what for.

The Witness (Continuing): My company makes and sells these water softeners and they go into the hands of the purchaser for the purchaser's own use. The defendant's authority over them is then not entirely gone. They usually ask for a guarantee and if they receive that guarantee they must operate the machine as we tell them to operate it. And, so far as I know, they do operate as we tell them in our operating instructions. We don't tell them to operate according to our advertising literature or something like that. Well, naturally we cannot go in and absolutely order them

to do that, but we ask them, insist on it and do as much as we can toward making them for their own benefit.

In the construction shown in Fig. 1 of the Gans patent in suit, I am now directing my attention to the structure and we will just leave aside any relation to what may or may not be in the specification, but in the use of a structure such as there shown if it is used in a down-flow direction for softening, the upper bed of sand or gravel above the plate *c*, and the bed designated by the letter *e* tends to remove turbidity from the water when, water is passed in an upward direction through that filter, just as there shown, if there be turbidity in the sand bed *g* would not necessarily tend to remove that turbidity. The sand bed *g* is put in there in this case as a
214 supporting layer and would be much larger than the sand possibly used in the filter above which is intended for a filter.

Q. No, but I am asking you this question, if this is a sand bed or layer *g*, and let us say salt water or any other kind of water be forced up through there, the effect of that sand bed would be to tend to eliminate the turbidity of the water, would it not?

A. I would like to make a rather full explanation.

Q. No, I want you to say yes or no first, and then we will see about the explanation?

A. And you are speaking of turbidity in water?

Q. I mean suspended matter, what we have called here turbidity. I am not using it in any technical sense, but solid, suspended matter in the water is my understanding of what gives rise to turbidity. Let us stop on that. Is that approximately correct?

A. Turbidity is usually small and suspended matter may be as big as one's finger.

The Court: Turbidity usually comes from suspended particles or physical particles, does it not?

The Witness: Quite right.

The Court: There isn't any difference between you, I think. In the mains of the city water of Chicago there is turbidity.

215 The Witness: Very bad.

The Court: I guess there is no organic matter, but physical foreign matter.

Q. Now, if turbid water be passed up through this sand bed G in Figure 1 of the Gans patent in suit, would not the tendency of that filter be to remove the turbidity from the

water? That is the question I want you to answer yes or no.

A. Yes; provided the sand was of sufficiently small size. Obviously if you place large gravel in there, a large sized particle, any particle, you would encounter—no water would thread its way through. If the sand were very fine it would thread its way through. If the sand is very fine it will begin to lift, the same as the zeolite bed does, and allow the matter to pass on through.

Q. Now, do I understand aright that this defendant's exhibit 64 is intended to represent the action of the pool that exists in the bottom of the container in the Brooklyn tests upon the zeolites when that salt-containing pool was forced up through the zeolites in Brooklyn?

A. It is an attempt to isolate and study some of the facts.

216 Q. No; no. I am asking you if that is intended to represent what did or did not occur under the exact condition of the Brooklyn tests.

A. You are holding to the exact conditions of the Brooklyn tests? No.

Q. Do you know how many parts per million of salt there were in the pool at the bottom on the first Brooklyn test?

Mr. Byron: That is stipulated, if you will just read the figures.

Mr. Cooper: Well, he can refer to the stipulation. I want to get a basis.

The Witness (Continuing): A number of samples were drawn and a number of different contents of the pool were obtained. I am not exactly clear on which one you mean. When the device was first stopped from operation, and the pool was first there as a pool for the purpose of that demonstration, immediately after the machine was stopped, I find there that a small sample was drawn from the lower cock, the one at the extreme lowest point of the pool, and the chloride content was found to be 8000 parts per million. A second sample was drawn and contained 28 parts per million of chloride. A third sample of the same was taken which showed 16 parts per million of chloride.

On this exhibit 64 the parts per million in chloride at the lower end of my curve are approximately 35. That is

217 what I have calculated here.

At the upper end of that curve in parts per million, it would not be ten times that; the top end would be 719, as I figure it here. This curve is based upon an exhausted green

sand zeolite; exhausted to the point where it did not give soft water to soap tests. And in the Brooklyn condition, when the salt pool was being investigated, the zeolites had been regenerated by the immediately preceding down-flow of salt water, followed up by hard rinse water, of course. It is my impression that that hard rinse water had reduced the softener capacity of the zeolites to some extent.

Q. Now, the total content of the pool at Brooklyn was seven and a half gallons, was it not?

A. The content of the space below that pipe, I understand, has been figured out to be seven and a half gallons, but I would not define that as the boundary of the pool.

Q. Then seven and a half gallons is the maximum content below the pipe in the Brooklyn test?

The Court: Below the material that was put in. I understand what you mean. That is not what you said.

The Witness: If the Court please, I do not believe he is indicating the space below the zeolites, but merely the space below the end of the pipe.

Mr. Cooper: I simply want to get on that basis with you.

218 A. I understand that seven and a half is below the end of the pipe.

Mr. Cooper: Yes.

A. In that curve portion.

The Court: Where the ring is.

The Witness: May I indicate?

The Court: It is below where the ring is.

A. Yes.

The Court: The ring is right below the pipe, isn't it; isn't that the ring there?

Mr. Byron: Yes; that is right, your Honor.

Mr. Cooper: Now, let's take your 6000 parts per million which you gave as the lowest limit of exhaustion under your company's instructions, as I understood you to say on your direct examination to its customers. That is, 6000 parts per million salt—I want to get on a basis with you about that—if you had seven and a half gallons in the space we are inquiring about, you would have 6000 parts per million, 350 grams expressed in salt or chloride, I suppose, per million, wouldn't you?

A. Well, I can figure it out; it will take some little time.

Q. You won't take my statement as being sufficient for the purpose of the question?

A. It will do; certainly.

Q. Yes. Well, seven and a half times that would be th
total amount of salt in the pool on that basis, wouldn'
tt?

219 A. If your first statement is correct; yes.

Q. And that would be all the water of half a pound
of salt, wouldn't it?

A. Let me refresh my mind on this. Your first quantity
of solution was how much?

The Court: Seven and a half gallons.

A. Seven and a half gallons. And your amount of sal
in grams?

Q. Well, I put it at 350 grams as representing 6000 parts
per million.

A. In seven and a half gallons?

Q. No; one gallon.

A. One gallon. That was my point.

Q. Yes.

A. It would be considerably over half a pound.

Q. How much would you make it?

The Court: How many grams in a gallon?

Mr. Cooper: Well, I was putting the grams on the weigh
side, to get the salt content.

The Court: How many gallons of salt were there in th
vat?

Mr. Cooper: I took the total content of water on the as
sumption of 60 pounds or parts per million.

The Witness: Something over five pounds. If I hav
220 understood it right. That is the way I calculate it
There are 454 grams to the pound.

The Court: That is, about five pounds, on the basis o
350 grams would be almost a pound.

Mr. Cooper: According to that. There must be some
thing wrong with my mathematics. I won't spend any mor
time on it. It is my own difficulty, your Honor; I was takin
grams where I should have taken grains here.

Q. 350 grains per million times seven and a half gets m
up to what I was driving at, which is half a pound of salt.

A. Something close to that.

Q. And a half a pound of salt would remove 1000 grain
of hardness, if that is the proper way of putting it, woul
it not?

A. That is the ordinary commercial figure.

Q. And in the bulk of zeolites in that size of bed that wa
there at Brooklyn, what would be the total grains of hard

ness, I mean, is that the way to express it, the total grains of hardness removed?

A. The total grains capacity of the zeolite bed.

Q. Yes.

A. As I am able to calculate the capacity of the defendant's softener of that size, it is 144,000 grains removal.

221 Q. So that on the assumption we have been carrying through, 1000 grains of that would be removed by that salt in that pool.

A. On that assumption; yes; although—No, I will not qualify.

Q. And if I indulge your further statement that the proper saltiness might be as high as 18,000 parts per million, then we woull multiply simply by 3 if I have carried through my calculation correctly on the 6000?

A. If your calculations are correct on the 6000; yes.

Q. And it is that hardness reducing effect which you have described in your direct examination as a vital function of this salt pool at the bottom?

A. Yes.

Q. Now, this salt which is in that pool, is that what you denominate or would denominate a dirty brine or a clean brine in the condition in which that pool was at the time this examination began in Brooklyn?

A. If I understand your meaning of clean, it is perfectly clear and—

Q. Well, it is composed, is it not, of salt which has come down through the zeolite bed and through the sand bed and has performed its regenerating function on the zeolite, and you say that it is clean, pure brine when it reaches the bottom?

222 A. It is relatively pure after the brine which has immediately preceded it. The matter of impurity is entirely relative in there.

Q. You mean because it is the last that has come through it is cleaner than any other that has come through?

A. Certainly; the taste is not bitter.

Q. And of course you do not mean pure brine in the sense of a water that has taken up all the brine, that took up, say, whatever it is, thirteen or fourteen degrees baume; is that proper?

A. That would refer to a saturated brine.

Q. A saturated brine. It is not pure in that sense?

A. It is not saturated.

Q. And about how many parts per million would there be in a saturated brine?

A. Do you wish it in parts per million, say in sodium chloride, or in ordinary chloride that we have stipulated here.

Q. On the basis we have stipulated. I do not want to get a new basis of calculation here.

A. This is a rough calculation, made rapidly, and it comes out 158,400. I may be wrong I can check it up if you wish to give me the time.

Q. Well, that will do for the present. Now, the first brine that comes down in step No. 2 on this plaintiff's exhibit 16, tends to sink to the very bottom of the container, doesn't it?

223 A. No; it does not.

Q. Your theory that it is the purest of the brines that have come through that remains here, is based upon the assumption that the force of water behind that has driven everything ahead of it into the sewer?

A. Perhaps not everything, but practically.

Q. Now, as a matter of fact, in the regenerating operation everything inside the container gets salty, it attaches itself to the walls of the container and to the interstices of he bed, whaever they be, so that the whole thing is salty.

A. It becomes salty and then rinses off; yes.

Q. And there is still salt left at the time the regenerating operation was stopped, as in Brooklyn and when you were beginning to investigate the pool there, there was salt left through the whole apparatus because there had been nothing to drive it off.

A. I would not say salt was there throughout the entire apparatus. We had had a rinsing operation at the top of the pool.

Q. You think there was no salt around the body of the container?

A. There was certainly salt left, but I am speaking of the top of the container and the upper portion of the bed.

Q. But throughout the beds, both the filter and sand, there was undoubtedly salt there?

A. The indications are there was.

224 Q. And that salt continued to come down for a very substantial period after they first began to investigate the pool.

Mr. Byron: That is all stipulated.

A. Yes.

Mr. Cooper: I just wanted to get the witness' understanding.

The Witness (Continuing): Now, this Rundschau article which I have talked about, I had occasion to state that that was an article emanating from Gans. I should like to make my position clear on that. The basis for the statement was what is in the article itself and not on any knowledge I have about it. I was stating my interpretation of the text of the article. I though Gans wrote it.

Q. Now you know it to be the fact, do you not, that in the normal operation of the defendant's softener, the salt pool is finally driven out to the sewer and does not get into the service lines; isn't that correct? What you have denominated the salt pool?

A. A portion of the salt goes into the service lines, undoubtedly, because in the upwashing the washing is continued only until the water becomes soft and ordinarily a portion of the salt gets into the service line.

Q. Well, I understood you to say that all the salt water that comes down at the inception of the regenerating action, all of that was driven out to the sewer by the last flow of water down.

A. Well, they follow through successively; yes.

225 Q. That does not quite answer my question, which was whether you didn't say that all the salt water that comes down first in the regenerating operation, that is all driven out by the water that comes down last, so that the remaining salt, the remaining water in the pool is, at the time of the Brooklyn investigation, was the purest salt water that had come through the bed.

Mr. Byron: Your Honor, that question has two little daggers in it and it is not clear. The question has two inconsistent parts, and I would like to have two separate questions on that. Yes would be right and wrong and no would be right and wrong.

The Court: He may answer it.

A. I don't remember using exactly those words, but—

The Court: Well, in substance.

A. I will state that the—

Mr. Cooper: Q. No. I want to know whether that conveys the substance of what you undertook to testify to.

A. The general substance I will agree to.

Q. Then why is it not a fact that the rest of that salt water

is driven to the sewer by the water which follows it and which ultimately goes to the sewer in washing and rewashing before the device is put into softening operation again?

Mr. Byron: May it please your Honor, the stipulation clearly brings out how much salt there is down in this
226 section at each period in question.

The Court: This witness is an expert. He may answer the question. He has a right to cross-examine him about such matters and test his qualifications, independent of any stipulation.

A. It seems to me that the further down you reduce the concentration of salt in the machine, the harder it becomes. As you go down you wash more and it is hard to get that last salt out, very hard.

Mr. Cooper: Q. That is all the answer you want to make to that question?

A. That is all I referred to.

The Witness (Continuing): I made some comparisons between the water that flower through on the plaintiff's tests in Brooklyn in washing and regenerating and washing and rewashing and so on, and the amount that was used for similar operations in the tests made by defendant at Hawthorne, New Jersey.

I have not figured out the bulk or cubical contents of the zeolite bed in the Brooklyn case and the cubical contents of the zeolite bed in the Hawthorne case, but I can give you a direct ratio. As I remember, the only one we had in the test at Brooklyn was 45 inches high. Obviously the one in the Rundschau device is 28 inches; 28 to 45 is the ratio. Oh, I have not checked it up to see if that ratio was exceeded in the amount of water used in the two cases, but I was not speaking from that ratio. I was speaking more on the water, of the amount, of capacity we obtained from the machine, the Rundschau machine, and the amount of capacity,
227 normally speaking, from the machine used in the Brooklyn test. That is the explanation I want to make.

I recall no statement of criticism or comment upon the fact that in the Brooklyn case and preparatory to the tests there, the bed was artificially hardened instead of having been naturally hardened by the passage of Brooklyn water. I have no quarrel about its having been artificially hardened, nor no question concerning it. My question assumed the necessity of adding artificial hardness to water which was going to be used to wash the salt out of the container when a relatively softer water would have done equally well.

But if it was desired to go through the complete cycle, first to harden and then to regenerate, the use of Brooklyn water with a hardness of one and a half or two would have obviously taken longer than by using a water artificially hardened up to 18 points. I made no criticism on that having been done in a hurry.

Q. Now, with respect to sodium sulphate, as I took it, you said that that has a delaying action or a slight interference with the creation of lather under these tests; that it will have some effect, and on being interrogated further, you said it will have an appreciable effect. That is really as far as you want to go as a scientist on that matter?

A. I would explain, on the basis of my interpretation—

Q. I mean on your statement, first, it has an appreciable effect?

A. That will stand; yes.

228 Q. Yes. And of course anything that exists in any quantity whatever has an appreciable effect, doesn't it?

A. That is a rather broad statement.

Q. I understood you to say with reference to the possibility of completely washing out the salt from one of these Graver containers that theoretically at least you could keep washing indefinitely and never get all the salt out, that whatever would remain after a million years would be an appreciable effect in a scientist's explanation.

A. Oh, no scientist could begin to determine that; certainly not.

Q. Not as exaggerated a statement as I made, but within limits, 24 or 36 hours, you would still say there would be an appreciable amount of salt in one of these containers after it had been flushed for that length of time?

A. Appreciable to the taste and appreciable to the Bureau of Standards in their analysis, that would be two different things. Certainly the Bureau of Standards could probably find it.

Q. So that what the Bureau of Standards could find in respect to the salt, that to you would be still an appreciable amount?

A. To them; yes.

Q. But to you from an operating point of view would be inappreciable?

229 A. I could probably analyze and find some of it. If I were tasting I could not find it.

Q. Its effect would be inappreciable for the purpose of such a test as you have just stated?

A. Of such a test?

Q. As you have just stated, the taste, for example?

A. Oh, I believe so.

The Witness (Continuing): With respect to this exhibit 19, which is the container and some of the other parts of the Hawthorne test, I say that there are holes in the inflow pipe put just above the point where that pipe enters the bottom of the casing. My authority for that, so far as actual disclosure goes, is not based upon this enlargement of the drawing that appears in the Rundschau article; I had never seen one of those enlargements. I think I can see them in the small illustration.

Referring to the top of page two of the translation of the Rundschau article, the raw water enters through a pipe in the pipe line H which is connected to the bottom of the permutit filter vessel, into the pipe C, which is perforated at its top, so that the water passes in uniform distribution through the sieve into the permutit layer. And I observe that arrows are given there, which I agree indicate the uniform distribution or flow of the water up there. Now, that is the same pipe, the one entering the bottom of the casing, which is also used as a drain pipe to drain out the salt as I have described before. That is the same pipe that afterwards is connected to the sewer to drain the water out, through this other drain. This describes, as I have read, quite particularly the course of the water coming in. It comes in through that pipe; it comes up through what you have called the laterals or the pipe C, as stated here, which is perforated at its upper side so that there is a uniform distribution of the water through the sieve into the permutit layer.

230

Q. Now, if there were those holes, which are unlettered, that would be an incorrect description, would it not, because the incoming water would force itself out of those holes that you have placed at the bottom of the container in that pipe?

A. Certainly, that small quantity of water would come out of there.

Q. Yes; of course, it would, but nothing was said about that in the description?

A. The amount of water is so small that it is—

Q. Well, why is it so small?

A. Those holes are not very large.

Q. How many of them are there as shown in this drawing, to your designing eye, in the article itself?

A. I think there are two this way and two that way (indicating).

Q. Wouldn't they, from your knowledge as an engineer, interfere with the uniform distribution of this water through a lateral pipe system such as C here.

231 A. In proportion to their size, I can count up the number of holes in the lateral system and the number of holes in the bottom and show you what the ratio would be; it would be very small.

Q. But there is nothing said about it and it would have some effect on the uniform distribution, would it not?

A. If you are speaking in ordinary limits, I would say no; in very fine limits, yes.

The Witness (Continuing): This material as fabric does not represent the fabric that was first put into this exhibit 19. The first material that was used there was much finer. The first material was not a linen as described in one of these two articles on this subject. It was not canvas it was a piece of a tent. It was a piece of waterproofed tent, pretty nearly waterproof. This is certainly not a piece of waterproof tent. It is a fairly loosely woven cloth. I can count the number of holes in any piece of cloth if it is necessary, I can certainly count them in this (indicating). When that other piece of cloth, the tent, was first put into exhibit 19, I am told that the plate was clamped down on top of it. That was the way we knew that it should be done, the upper part. I did not see it work with that piece of tent.

I am told that the rubber gasket was put in at the time that the second cloth was put in. The rubber gasket was associated with this piece of cloth to keep it from leaking around the edge. I do not know what they call cloth of this variety that was introduced yesterday by the defendant.

232 I notice that there is some excelsior, small pieces, scattered through that sample of this pail of zeolites, Defendant's exhibit 14.

In 1924 or some such time I tested my first Decalso. Asked if the grains are porous, the individual grains, I would say it is impossible to see those pores under an ordinary microscope; I looked for them. If you would like my opinion, I will tell you. My opinion is it is porous, of course. One does not have to see through a microscope to know that it is porous, because if it is porous it will absorb water. You can determine that function and draw your own conclusions. I am not informed if there is still upon the market in this country a zeolite known as permutit. I have not been interested. I understand the Permutit Company sells zeolites. To the

best of my knowledge my company does not buy a zeolite known under the trade name of Permutit. It does buy this Decalso. It buys it from the concern whose name is prominently printed in the casing of this exhibit 19, the American Zeolite Corporation. That is the company with which Mr. Riley is connected.

233 If a porous zeolite like Decalso were packed in a bed, even if tightly, water would percolate through the bed.

Q. Going back for a moment to your criticism of the Brooklyn test, as I take it, didn't you state there was no reason for having hardened the Brooklyn water artificially; and as I understood your explanation this morning, it was that there was no reason to have hardened it at all, where the only question was the degree of saltiness in that pool. You certainly do not mean that, do you?

A. Any reason for hardening the water?

Q. Yes.

A. The only question of saltiness in the pool?

Q. Yes.

A. A two grain water would be perfectly satisfactory to wash out the salt, I believe.

Q. Well, but the bed must have been hardened artificially before you could get—I mean, the bed must have been hardened completely before regeneration, in order to determine the after effects, must it not?

A. It was exhausted. I am not concerned with whether it would be exhausted with Brooklyn water or whether it would be exhausted with an artificially hardened Brooklyn water. I am speaking of the rinsing action.

Q. The brine in your surve, defendant's exhibit 64, does not contain any calcium at all, does it?

A. No appreciable amount, it was c.P., it was chemically pure, the sodium chloride is.

234 Q. If it had contained calcium in a substantial amount, would the curve have been the same or different?

A. I would like to know exactly what is meant by a substantial amount. Of course, obviously, if the brine contained a tremendous amount of calcium, it would have no great regenerative effect.

Q. Well, if it contained no appreciable amount of hardness as distinguished from the basis of its dirt, the curve would have been different, wouldn't it?

A. The curve would have been different, but would still have shown the same general regeneration.

Q. That last is argument. I asked you would the curve be the same or different, and you may leave the argument to your counsel.

A. I am sorry.

Q. Would it be the same or different?

A. It would be the same.

The Witness (Continuing): The curve is not based upon ideal or theoretical conditions; it is based upon a desire to isolate a certain function, agreeing with Mr. Tiger yesterday, it is hard to analyze for calcium or to analyze the regenerative effect, when you have some calcium already present in the raw water. In the same fashion Mr. Tiger pointed out yesterday if they had passed water hardened with chloride through the machine, you would have to test up between to certain limits; I never disagreed with that.

235 *Redirect Examination by Mr. Byron.*

I am told the zeolites in the Graver tank tested by Plaintiff at Brooklyn were Permutit zeolites; the type of sand was green sand, it is classified in ordinary practice as a non-porous mineral.

Mr. Byron: Is it porous or not?

The Witness: It is porous.

Recross Examination by Mr. Cooper.

When I said it was classified as a non-porous mineral, I was not speaking of the raw green sand. I am speaking of competitors catalogs which I have read; possibly some of our own older literature. The type of Permutit that is made from green sand is porous in my judgment.

236 RAY RILEY, being first duly sworn on behalf of the defendant, testified as follows:

Direct Examination by Mr. Byron.

My name is Ray Riley, age 26, residence 71 Hamilton Avenue, Paterson, New Jersey. I am a chemical engineer employed by the American Zeolite Corporation of Paterson, New Jersey. I have charge of the factory in which decalso is manufactured. I also look after certain technical work in

regard to the application and use of the chemical in various water softeners of our customers.

I received a B. S. degree in chemical engineering in the Oklahoma Agricultural & Chemical College in 1924. I received a Master of Science degree in chemistry from the same institution in the summer of 1925. I received the degree of Doctor of Philosophy in the Iowa State College in March 1929. My major was chemical engineering to get the doctor's degree.

Hawthorne, New Jersey, adjoins Paterson. From our plant to the Hawthorne Laundry is probably between one and two miles. From where I live in Paterson to the Hawthorne Laundry is approximately a mile further. The Hawthorne Laundry is quite accessible from our plant.

Defendant's Exhibit 19, the apparatus we are calling the Rundschau softener, was shipped to and received by the American Zeolite Company in Paterson, New Jersey.

237 I was out at Ames, Iowa at the time the softener came in.

I first saw it when I returned from there. The exact date I saw the softener I cannot say, but it was between March 25th—I can give you the exact date. It was two days previous to the first Brooklyn test, which I believe is stipulated to be March 27th. At that time the softener was at the plant of the American Zeolite Company.

I will tell what happened to that water softener from then on.

I had charge of the installation and operation of the water softener from the time that it was received by the American Zeolite Corporation, installed in the Hawthorne Service Laundry and shipped back to the Graver Corporation. It was shipped from Paterson, as I remember, October 16th. It was taken down under my supervision.

According to my notes in the log that I have on the apparatus, the Rundschau softener—

Mr. Cooper: Excuse me. I would like for the witness to testify from memory. If he wants to refresh his recollection by these notes, I am perfectly willing that he shall, but I would rather not have him state the contents.

The Court: State your recollection wherever you can, not from your notes, but from your recollection. If you fail to remember what occurred you may refresh your recollection, but the purpose of testimony elicited from you is to test your best recollection upon the subject.

238 The Witness (Continuing): The softener was installed on April 6, 1929. The first water was run through the softener on April the 8th, 1929. It was installed on Saturday, and we did not run any water through it until Monday morning, as the work was finished up late Saturday.

A slight change was made on the softener—not on the softener I should say. The cloth was changed in the top of the softener April the 9th, at the same time the rubber gasket which has appeared before the court was inserted. The reason that the rubber gasket was not inserted in the first place, no one asked me to put in a rubber gasket. I chose the rubber gasket myself. I did not have the rubber gasket at the date of the installation of the softener. I ran the softener one day at approximately 18 gallons from the softener. The softener was working perfectly at this flow rate. Then I decided to see how well the softener would work at a higher flow rate, and I chose the other cloth and inserted it on April the 19th. That cloth is the cloth which is before the court and was in the softener from April 9th until it was removed from the softener September 12th, at the time the test was run on the softener in the presence of the Permutit representatives.

The excelsior which was placed in the softener, which was removed September 12th, was placed in the softener April the 6th, the installation date of the softener.

The water was first actually used in the laundry, in the wash tub of the laundry May 13th.

239 Your Honor, I would like to look at my notes to verify that date. I think it is right.

On May 14th, Mr. Byron and Dr. Moses went with me to the Hawthorne Service Laundry, and we looked the installation over and observed the operation of the softener. Shortly after May the 14th the question arose as to the use of soft water throughout the laundry, which meant for washing purposes and in the boiler. Such a use of the soft water completely throughout the laundry meant a slight change of pipe line, the installation of two pumps. One to pump the water to the wash tubs in the laundry, another pump to take care of the boiler feed.

I would like to point out at this time that the boiler feed pump—it was necessary to install the boiler tube pump as the water pressure at this laundry is quite high, and the city water pressure was being used up to that time for the addition of the required quantity of water to the boiler.

The pump, a centrifugal pump which we contemplated and did install for the pumping of the water to the wash tub, did

not deliver a sufficiently high pressure of water to the boiler.

The softener was regenerated and handled as a softener is ordinarily handled in a laundry. A few times the softener was regenerated before the bed was actually dlivering hard water, the reason being that I was familiar with the relative amounts of water that were used on the different days in the laundry, and if the softener was sufficiently near exhaus-
240 tion that it would not run the following day without overrunning the softener to a marked degree, the softener was regenerated.

In some cases during the operation of the softener there, the softener was over-run to a fair degree, a custom which occurs in laundries in case they use more water than they think will be necessary, and over-run the softener once in a while.

The softener was handled, operated, cared for, in accordance with the operating instructions which were taken from the Rundschau article.

Now, I perhaps better describe the methods of regeneration which were employed in theh operation of this softener.

241 I will refresh my recollection from my notes taken at the time of the test: The softener was regenerated—the first run on the softener was started April the 8th and was completed April the 18th. 8,748 cubic feet of seven grain water was softened during the run. The efficiency of the zeolite based on exchange per pound of material in the softener was 326 grains per pound on the first run. This efficiency is comparable with that obtained from other types of softeners in which decalso is used on the first run.

The softener was first regenerated on April 18th and 19th, with the operation instructions as taken from the Rundschau article. On this regeneration I might add that six pails of the salt solution from the bottom of the softener were returned to the top of the softener. The same quantity of salt was used on this test as was used in the test September 9th in the presence of the Permutit representatives. 94 cubic feet or 705 gallons of water were required to wash the salt from the zeolite bed and obtain soft water soap test equivalent to five drops B & B.

242 On the second run 6,950 cubic feet of seven grain water was softened. In this instance the efficiency of the zeolites was 260 grains per pound; based on the hardness of the water seven grains per gallons.

The efficiency of the zeolite on this second run was a little

higher, due to the fact of the amount of salt used and the relatively long time for the regeneration, namely I used six hours for drawing off the six samples of salt and returning them through the softener. This was completed April the 29th, 1929. The run was intermittant. The flow rate was changed numerous times. The flow rate was run at various rates between 30 and 60 gallons per minute when the softener was running.

The softener was regenerated April the 29th with 150 pounds of salt. I might state that in this regeneration the salt entered the top of the softener as the water was drawn from the bottom of the softener. The softener was not allowed to stand. The run was completed May the 3rd, 6,000 cubic feet, 45,000 gallons of water were softened during the run.

The softener was regenerated May 6th with 150 pounds of salt, the flow rate was intermittent at approximately 50 gallons a minute throughout the run. The run was completed May 15th. 45,187 gallons of water were softened.

Now on May 10th and 11th, the softener was connected to the wash tub of the laundry where the water was used on May 13th.

243 The softener was regenerated May 15th with 150 pounds of salt. The run was completed June first. The water was not metered on this run since most of the water was run to the sewer, and I did not have any meter on the wash line going to the sewer; only the water was metered which was used in the wash tub, which reading I did record.

On May 19th, the Rundschau apparatus was opened. By that I mean the top perforated plate was removed. I thought I detected a faint odor, a thought which I was never able to confirm. In other words I was very critical in the observance of it, and I was looking for any possible discrepancy that I might observe, and I might have been a little bit suspicious. In other words that was one thought that I had that I could never confirm, as far as the door of the excelsior was concerned.

The centrifugal pump now in the laundry to pump the softened water to the wash tub, was installed May 31st and June 1st. At the same time the necessary pipe was installed to run the raw water to the softener so that the original pipe line could be used as a low pressure soft water line to the wash tub.

The feed water pump to take care of the feed water to the boiler was installed June 7th and 8th, and June 14th and

15th. Soft water was again put in the laundry for a short time on June 17th.

The softener was regenerated June 17th with 150 pounds of salt. During this run the water was not metered.

During the week of June 15th to 22nd, the extra side connection was placed on the softener above the perforated
244 plate in the top of the softener. This was used to get a better flow of water to the centrifugal pump which pumped the water to the wash tubs in the laundry.

The softener was regenerated June 24th with 150 pounds of salt. All of the softened water was used in the laundry during this run and the following run.

From the date of June the 24th, the water, the softened water was used continuously in the laundry.

The softener was regenerated July first, with 175 pounds of salt. The flow rate was 60 gallons per minute, 45,470 gallons of water were softened. The soap test at the end of the run was equivalent to five drops B & B.

The softener was next regenerated July 6, 1929, with 175 pounds of salt. The flow rate 60 gallons per minute; 42,300 gallons of softened water were delivered; 650 gallons of wash water was used to wash the salt from the softener after the draining from the bottom of salt.

The softener was regenerated July 12th, 175 pounds of salt; flow rate 60 gallons; 34,920 gallons of soft water.

This is one instance in which the softener was again regenerated before the soap test ran five drops B & B, as on the following day the laundry would have required approximately 20,000 gallons of water, which would have meant a final running of over 50,000 gallons of water, which was above the capacity of the softener, and I did not intend at that time to over-run the softener.

245 The softener was regenerated July 15th, with 175 pounds of salt; flow rate 60 gallons; 40,890 gallons of water were softened.

The next regeneration July 22, 1929, 175 pounds of salt; flow rate sixty; 43,780 gallons of soft water. 600 gallons of water were used to wash out the salt. Soap test five drops B & B equivalent.

The next regeneration July 27, 1929, 175 pounds of salt. At this time during this run the flow rate was very much above sixty gallons per minute. It was approximately 80 or 90 gallons per minute. 40,270 gallons of soft water were delivered.

The softener was regenerated August 3, 1929, with 175

pounds of salt. The flow rate again was high. 52,300 gallons of water had passed through the softener at the time it was stopped. The soap test was approximately equivalent to eight drops B & B. It was equivalent to three drops of soap solution which I was using at that time, which was not the standard B & B. As far as the B & B soap test was concerned it was hard at that time. In other words this was one time that I over-ran the softener.

The softener was regenerated August the 10th with 200 pounds of salt. Flow rate sixty gallons per minute. Gallons of soft water 44,690. Soap test five drops B & B. I actually used B & B soap test from here on; not a test which was equivalent to the B & B.

The softener was regenerated August 14th, 170 pounds of salt; flow rate sixty; gallons of soft water 44,090. Soap test five drops, that was five drops B & B then not five drops of our solution. Five drops of my solution,—my soap solution that I used at the beginning was harder than the B & B soap, a stronger solution than the B & B I mean to say.

246 The softener was regenerated August 12th. In the first set of tests I used a two drop test, the two drops being two drops in twenty C. C., equivalent to five drops of B & B in 40 C. C. I checked this a number of times. Now then in both sets of tests however, the soap test was identical, that is in effect. Two drops of the stronger soap or five drops of the standard B & B.

The softener was regenerated September 3, 1929; 200 pounds of salt; 60 gallons flow rate; 49,050 gallons of soft water. The soap test, six drops B & B.

Regeneration September 6, 1929, 200 pounds of salt; 60 gallons flow rate; 43,650 gallons; soap test five drops B & B.

The softener was regenerated September 9, 1929. 400 pounds of salt were placed in the salt tank. The softener was regenerated as it was regenerated on September 12th, before the Permutit representatives, exactly. Six samples of contaminated brine were returned through the top of the slot at ten minute intervals until the softener was completely drained, and wash water washed up through the bed over the top of the softener instead of to the drain until the water gave a soap test of five drops B & B.

I do not have the gallonage of water softened at this run for a number of reasons. In the first place I knew that the softener was to be tested on the 12th; I did not have time to finish up this run, to get another run off, and I had been re-

quested to have the softener approximately exhausted for the test; so after the softener had reached approximate exhaustion I stopped the softener, allowed the water to go to the
247 laundry on passing through the softener, consequently in my readings that I could take at that time, I did not rate the amount of water which passed through the softener.

The softener was regenerated September 12, 1929 in the presence of the Permutit representatives. The material was as stipulated in the test. The softener was empty. Before the softener could be placed back in operation, it was necessary to again place the gravel, zeolite and so forth back in the softener. The canvas and the excelsior were removed from the softener to be sent to the Graver corporation at the time of the test. I recognize all these parts as the parts which I sent; the zeolite, the canvas, the gasket and the softener.

On re-filling the softener it was necessary to put in new excelsior and a new cloth. The gasket was left behind, and I used the same gasket which was sent out to the Graver Corporation at the time the softener was returned.

The zeolite that was removed from the softener was placed in the softener; approximately a cubic foot was sent to Graver. The Permutit people took one or two small samples, and I took a sample to the laboratory. I replaced the quantity of zeolite which had been taken by various people for different purposes, with new material, so that the charge that went back in the softener was identically the same zeolite which was originally in the softener with the exception of the replacement of approximately 60 to 70 pounds, I would say, which had been removed for various purposes, after the first test.

248 The softener on this run delivered 57,400 gallons of water before it was stopped. The soap test was eight drops. In other words the softener was over-run to a partial extent.

The softener was regenerated September 21, 1929, with 140 pounds of salt. The flow rate was 60 gallons. 40,170 gallons of water were softened. The soap test, five drops B & B.

The softener was regenerated September 24; 140 pounds of salt; 60 gallon flow rate; 44,070 gallons of water were softened; soap test five drops.

The next regeneration was September 24th, 140 pounds of salt; 60 gallon flow rate; 44,070 gallons; five drops B & B.

Regenerated September 30th, 140 pounds of salt; 60 gallon flow rate; 42,190 gallons; five drops B & B soap test.

Regenerated October 5, 1929, in identically the same manner as was regenerated September 12th in the presence of the Permutit representatives. The flow rate was 60 gallons per minute; 52,210 gallons of water; six drops B & B soap test.

The last regeneration was October 12th. 160 pounds of salt were used; flow rate was 60 gallons per minute, but the softener was dismantled before the run was completed.

As a result of my several months tests of the Rundschau device—Defendant's Exhibit 19 is what you identify by the term Rundschau device—and as the result of my experience in my opinion the device is a successful commercial type of device which can be used in softening water as the softener is ordinarily used at the present time.

249 The performance of the softener was splendid throughout the number of months which I tested it. The efficiency of the zeolite, that is the exchange capacity of the zeolite in this softener throughout all the tests was very good. I received better values as far as the exchange capacity of the zeolite is concerned than we ordinarily recommend our customers to rate the decalso as used in their softeners. It compares favorably with the operation of all lthe softeners which I have come in contact with.

After the original change from that first piece of cloth to the second piece of cloth which is now here in court as one of Defendant's Exhibits, that cloth was used continuously from the date it was placed in the softener April 9, 1929, until it was removed at the time of the defendant's test September 12, 1929.

I changed over to this cloth—the first cloth was working perfectly all right at the flow rate of 18 gallons a minute. That is the flow rate mentioned in the Rundschau article. I decided to run the softener at a faster flow rate. I chose a more porous cloth for that purpose.

I never have testified in a suit before.

Cross-Examination by Mr. Cooper.

I was there at this laundry in Hawthorne on other days than those I have specifically mentioned in my Direct Examination and made tests on the softener while it was operating

on these runs. I did not record any tests except when the
250 softener was started and stopped. When this Exhibit 19 came to me the cloth was not in place. There was a cloth included in the shipment, and that was a piece of tent about which Dr. Moses spoke. And I mounted that beneath the plate, the two part perforated metal plate. I attached it by bolts passing through holes in the piece of cloth and through the rim that adheres inside—the ring that adheres inside of Defendant's Exhibit 19. I might add this, that the cloth as I received it was not cut to the shape of a softener. It was necessary for me to have the cloth cut and the necessary holes placed in the cloth around the edge in order to place it over the bolts which are in the rim around the edge of the top portion of the softener. It was done under my immediate direction, and then the water was turned on at the rate of 18 gallons per minute. When the water was turned on the water did not boil around the edges of the cloth. I could hear—that is the water that was coming up from the bottom. I could hear a little hissing sound which I think was air escaping from around the side. Consequently I concluded immediately that I did not have a very tight seal around the side, and I ordered the rubber gasket.

Q. Now then you had that put around the sides so that no more air would hiss through around the edges?

A. I would like to make it plain—

Q. No, I am asking you the question. Do not make a point. Answer the question.

A. Maybe I haven't made myself plain. I stated that as the water—

251 Q. Wait a minute, Doctor. There is a question here which I want answered.

A. Air was in my opinion escaping around the side due to the displacement of the air which was in the dry zeolite bed at the time it was placed in the softener.

Q. And in the new arrangement by the use of the gasket you sealed around the edges of the new cloth, but you selected a new cloth with large holes in it relatively, so that the air would go through the cloth; is that correct?

A. New cloth was selected after I decided to run the softener at a higher flow rate. At that time I was not considering the passage of the air up through the cloth.

Q. When you raised the rate of flow in the Hawthorne device from eighteen to about sixty gallons per minutes, did you increase the depth of the zeolite bed?

A. I did not. That zeolite bed was the original depth of

bed that was specified according to directions that I was following.

The Witness (Continuing): The second cloth, the one that I used with the gasket after the first eighteen gallon run, was continued in service until the demonstration before the Plaintiff's representatives in September of 1929. Since that time that piece of cloth has not been used; it was not put back in the softener.

252 I might say the cloth I put in the softener after that was a cloth exactly the same material. At the time I got that cloth I got enough material to make two cloths. I am sorry I don't know myself the name of that cloth. I did not ask for sail cloth. I did not ask for linen. In fact I got that cloth—I saw a roll of that cloth in a room in a building in the Wideman plant. We are located, our factory is located in the Wideman Plant in Paterson, New Jersey. I saw a roll of this material. I asked the lady in that room if I could secure some of that material and have her make it into a cloth. She said she could. Or I asked her to cut it into a cloth of desired proportions, and she said she could. I did ask her the name of the cloth and she told me but I absolutely have forgotten. What she did in making a cloth was to cut off a piece the size I wanted or pieces the size I wanted. I saw a cloth that was porous.

I saw a cloth which was more porous than the cloth which I was using, and which in my estimation should work satisfactorily in the top of the softener at the high flow rate.

Mr. Cooper: Q. Now, I have a great curiosity on one point, and that is why at ten minute intervals in six installations on a number of these tests or examinations or runs, you were withdrawing two and a half gallons of salt water or fluid of some sort and pouring it back into the casing. I should like to have your specific authority for withdrawing on six installations, at ten minute intervals, two and a half gallons per installation.

253 A. In the agreed translation of the Rundschau article, page 1010 almost half way down the page, the sentence starting:

"This is allowed to react with it for about six hours with intermittant draining through valves *i*, and subsequent return through filter."

As I pointed out in the first regeneration I withdrew the samples one hour apart. Six hours was the time of contact, the time the salt solution was in the softener, as pointed out in this translation of this article.

Q. That was your authority. May I ask you if your notable qualifications include an ability to translate german?

A. I would not—

Mr. Byron: Understand I have not qualified the witness on that.

Mr. Cooper: No, I am simply asking for that information.

A. I know a little about German but I cannot say I am qualified to translate German.

Q. Well, have you looked enough at the original German of this article to find out whether or not it says anything whatever—

Mr. Byron: Your Honor—

Mr. Cooper: —about subsequent return?

Mr. Byron: Your Honor, we have an agreed translation here.

Mr. Cooper: Subject to correction.

254 Mr. Byron: And that is the best thing we had. If Plaintiff wants to put on a translator, it is perfectly agreeable o me, but they have got to prove that this is inaccurate.

The Court: He may answer.

A. I have looked at the article, but I could not say whether subsequent return is meant is not. I was following the agreed translation for my orders.

Q. If I have my figures correct on this point, the translation in speaking of the regeneration with 150 to 180 kilometers of salt states an equivalent for 330 to 396 pounds on our table of weights and measures; is that correct?

A. You are correct.

Q. Yes.

A. This quantity of salt was dissolved in the softener. The salt tank——

Q. Just a moment. I asked a question and got an answer and I would like to put another one.

And when the agreed translation says 900 to 1000 kilometers of water, that again may be translated into our system as the equivalent of approximately 250 gallons?

A. Yes, approximately 250 gallons.

Q. Now, if I understand aright, it was Mr. Moses who had the construction of the mechanical device made, and it was you who selected the materials to be used for softening and regeneration, and it was you who assembled the 255 thing into a working softener; is that correct? By assembling, I mean putting inside your materials, and mounting the cloth and so on?

A. I followed his blue print of the apparatus which he furnished me.

Q. And you were the one who selected your own company's product, that is the decalso type of zeolites, was and is your own company product?

A. I had nothing to do with the selection, with the job of running that softener. I am the one that had to run it and take care of it. I had nothing to do with the selection.

Q. Who picked decalso as the material to put in?

A. I don't know whether I could answer that question or not. The softener was set back there and I was told that I was to operate the softener. There was only one material—we manufacture only one material, and that was decalso. Nobody told me to go out and buy some other material so I naturally assumed that I would use something that we had there in the plant.

Q. That is what I asked you at first. Wasn't it you who selected the material that went in?

A. Under those conditions, yes.

Q. Do you recognize this as the sample to which you referred on your direct examination as having been taken off the plant on the occasion of this September demonstration?

A. That has the appearance of the sample which I saw them collect at that time. The sample of course was wet at the conclusion of the test.

256 Q. Then so far as you can see, this is still wet, and on the assumption that it was sealed at about the time, it would be a fair deduction that this is in about the same condition as when the sample was taken?

A. It could not have been sealed—it was not sealed at the plant. Assuming it was sealed within a short time, yes. Pure assumption though.

(Sample marked Plaintiff's Exhibit "H" for identification.)

Q. This Exhibit H for identification then ashows excelsior from the excelsior bed with some decalso mixed up in it?

A. There is some decalso in there, yes.

Q. And you have looked at the sample of dry decalso which was offered in evidence yesterday, I believe, sufficiently to see that that decalso which was taken from the bed has excelsior in it?

A. There is some excelsior in the sample.

Q. Now, with respect to the sample of excelsior, which was brought in here yesterday and offered in evidence, that

is dry, relatively brittle and hard, isn't it? There is no evidence of water in there?

257 A. No, this is material as dried.

Q. As dried. When and by what method was that dried?

A. I let it dry in the air before placing it in that container.

Q. It was just allowed to dry in the air?

A. Yes.

Q. Being a Jersey man myself, I can ask you with some show of assurance if it is not the fact that the Hawthorne water is noted as being relatively free from turbidity?

A. I have never heard the water spoken of or referred to in that manner. I had no—I went to the engineer who had charge of the installation of the system, and he tells me that it is a well water.

Q. As an expert or a man who has been looking closely at such things, is it not a fact that that is a clear water as waters are classified between clear or turbid?

A. I would classify it as a clear water. That is a well water, and most well waters are usually clear water. I do not consider that to be a specifically good well water, nor do I consider it to be a particularly bad well water. I would call it a good average well water.

Mr. Cooper: Q. What was the total content of the water in this Exhibit 19, when you took the two and a half gallons off at intervals as you have described?

258 A. Do you want to know the total gallonage?

Q. Yes. From how much did you withdraw the two and a half gallons?

A. Two and a half gallons was drawn from the drain pipe at the bottom of the softener. The softener was filled to the same height, I would say, as in the test in the presence of the Permutit representatives. I believe it is stipulated in that test that 220 gallons, if I remember correctly, of brine were in the softener, at the time the valve was closed from the salt water tank.

Mr. Byron: Plaintiff's expert just whispers up to me that it was 242. That is satisfactory, is it?

The Witness: That is practically the same quantity. It could not vary over a very few gallons.

259 Thursday, October 31, 1929.
Two o'clock p. m.

JACOB BACHMANN, being first duly sworn on behalf of defendant, testified as follows:

Direct Examination by Mr. Byron.

My name is Jacob Bachmann; age 41. I reside at 48 John Ryle Avenue, Hawthorne, New Jersey. My occupation is laundryman at the Hawthorne Laundry Company, Hawthorne, New Jersey. I have been connected with that company seven years, as manager and part owner.

I have been present at the laundry continuously since March or April of this year. I recognize the water-softening apparatus in this court room, identified as Defendant's Exhibit 19. I know definitely that the water softened by passing through that apparatus was used in my laundry. It was washing water, rinsing water, and boiler water; throughout the entire laundry. One evidence to show that the water that actually came out of that device was soft water is a saving of soaps and soda. We saved approximately thirty per cent. Between thirty and forty.

There was evidence after about two weeks, that this machine, Defendant's Exhibit 19, produced soft water in so far as the boiler water supply was concerned. My experience over a period of years with respect to treating our boilers for scale was either with a compound or soda. I have reg-
260 ularly treated our boilers with a compound for removing scale. The scale is a limestone formation on the tubes. It looks white.

The Court: Such as used to form on the tea kettle setting on the stove?

The Witness: Positively.

The Witness (Continuing): I actually saw lime on our boilers. I felt it, it felt slimy. This boiler compound to which I have referred did not prove as effective as the soft water in removing the scale.

When the soft water from this water-softener device, Defendant's Exhibit 19, was first fed to our boilers in the laundry, there was scale on the boiler tubes. And after I started using the soft water from the softening device, I did not use any more boiler compound for removing the scales.

After I started to use the soft water from the softener it partly dissolved the slime and the mud which caused the boiler priming. I looked into that boiler to see if that was the fact. I looked into the boiler about every three or four weeks. I should figure roughly about fifty per cent of the scale was removed up to the time this water softener, Defendant's Exhibit 19 was removed from our plant.

261 During the test of the water softener on September 12, 1929, of the water softener in question, right next to the room in which this softener was being tested, there was a large cylindrical machine, a washing machine, from which a foam was passing and there was considerable comment about that machine. The things that were being washed or treated in that machine at the time, are what they call tin bags from the die houses which were loaded with tin and phosphate and it is only natural when you start washing those with soda and steam up the water it will start foaming. We use no soap on any of those bags. It would not pay us to use it.

Cross-Examination by Mr. Cooper.

Dr. Riley was in and out of our place all the time that this exhibit 19 was in service there; he was out at times, off and on. He was in charge of the apparatus. We neither bought it when came nor sold it when it left, nothing to do with it.

262 LUCIUS A. FRITZE, being first duly sworn on behalf of defendant, testified as follows:

Direction Examination by Mr. Byron.

My name is Lucius A. Fritze, my age 41. My resident is Oak Park, Illinois. I am executive engineer, Elgin Softener Corporation. I am a graduate of Bradley Institute in Mechanical Engineering, a graduate of the University of Illinois in Chemical Engineering. I have had additional work in Pittsburgh in biology and bacteriology.

I have been in the field of water-softening, water-purification, water filtration, eighteen to nineteen years. I have been the chief chemist in the Pittsburgh laboratory of the American Waterworks and Electric Company, the former American Waterworks and Guarantee Company, an organization that owns and operates some 45 waterworks and filter plants in

this country. I have had charge of the waterworks and filter plant for Moline, Illinois.

In 1917 when the war broke out I was one of a committee of three to write the laboratory water manual for the United States Army. At the close of this work I was placed in charge of the water service of the Rainbow Division in France and prior to the Armistice I was placed as commanding officer of the divisional field laboratory in charge of the pathological and bacteriological work of the division, in addition to the water service. At the signing of the Armistice I was placed in charge of the water service for the Third Army, the
263 army of occupation in Germany. At the close of my work in Germany I returned to this country and was appointed to the History Commission, writing Chapter 20 of the World War History on furnishing water for troops in the front lines and in battle. Since the war I have been identified with organizations manufacturing both the downward flow type of zeolite softener and upward-flow type of zeolite softener.

The evidence has disclosed that there are two types of systems, one the downward-flow softener, where the hard water enters the top and passes downward through the softener with the soft water removed at the bottom, and the second type the upward-flow softener, where the hard water enters at the bottom, passes upwardly through the zeolite bed and the soft water removed at the top. The operation of a downward-flow softener as disclosed wherein the hard water enters at the top causes packing of the zeolite bed. Now, there are two distinct losses which occur from downward-flow operation, one of them being that the bed in packing prevents all the zeolites entering into the softening action and hence the capacity of the softener between regenerations is reduced. The second loss is the fact that in the downward-flow softener the packing of the bed reduces the quantity of water which can pass through the softener per hour and per minute, and there is a third loss in that the friction of the water passing through the softener reduces the available pressure on the discharge side.

264 In the upward flow type of equipment the elimination of the packing of the bed permits practically all of the zeolites to enter into the softening process and in so doing the capacity of the softener for regeneration is naturally increased.

Regarding the flow rate of the softener per hour and per minute reduction in the friction loss through the bed permits a higher rate of flow and hence more water can be secured per

hour and per minute. In connection with the friction loss, the loss or pressure over an operating period is practically no greater than the operating pressure when the softener is first placed in service.

Now, in showing the value of these advantages in operation in field service, I have in my hand the reprint of a paper that was read before the American Waterworks Association in June, 1927, at Chicago. This paper pertains to an installation of water-softening equipment that was installed at the Beacon Street station of the Detroit Edison Company, Detroit, The Detroit Edison Company was planning to install a central—

Mr. Cooper: May I ask, it may be implied in the witness' statement, is this article of your own authorship?

The Witness: It is a published article that is in the trade press.

Mr. Bryon: Q. Who are the authors of the article?

265 The Witness: The authors of the article are Professor White of the University of Michigan, Mr. Walker of the Engineering Department of the Detroit Edison Company, Dr. Edward P. Partridge of the University of Michigan, associate editor of the American Chemical Society, and Mr. Leo F. Collins, Chemist in charge of the plant.

Mr. Cooper: I object to the competency of the document. It seems to me that if the statements contained in this are to go in evidence the authors should be called.

The Court: There has not been any offer yet.

Mr. Cooper: I understand, but why should there be any description of what this is and what this proposes to do. I did not interrupt him until he started to say what the facts were upon which it was based.

The Court: Your objection is that the answer is not responsive to the question?

Mr. Cooper: Yes, that's it.

Mr. Byron: Q. Does this article express your views?

The Witness: It does.

Mr. Byron: Now, please state what is in this article.

Mr. Cooper: I will object to that as secondary.

The Court: Objection sustained.

Mr. Byron: What we propose to show is that men of authority have from an unbiased point of view shown that an upflow type of water-softener in the biggest unit in the United States, so far as we know, was installed and is in successful operation.

266 The Court: But you are asking him to state the contents of a written instrument, written document. I don't think that's proper.

Mr. Byron: We can offer the document itself.

The Court: I don't think the document is admissible because it must be identified by the author. Is not that true?

Mr. Byron: Q. Will you please state what you know about the particular installation in question at the Beacon Street station?

The Witness: I handled the sales and technical details of the purchaser prior to the purchase of the equipment. I visited the ground where the equipment was to be installed, both before and after installation. The Detroit Edison Company asked for equipment capable of handling eight million gallons of boiler water every 24 hours, a quantity of water equal to the pumpage for all municipal purposes in a city the size of Peoria, Illinois. The Beacon Street station was to be located on expensive real estate in Detroit and the Engineering Department of the Detroit Edison Company desired to secure equipment which would produce the maximum quantity of water per hour and per regeneration with the best efficiency and after a most thorough investigation of both the upward and downward-flow type of softeners, selected the upward-flow softener for the Beacon Street station. This article discloses the results which they have secured from the installation of this equipment.

Mr. Cooper: I think I will object to what the article discloses.

The Court: Well, that does not give us any facts about it.

267 The Witness: (Continuing) In view of the size of the plant it was necessary to install the boilers and mechanical equipment, softeners and all in units. The water-softener included two units at the start with the ultimate layout calling for five or six units to take care of the peak demand. The initial order was for two units. The softener have given good service and have met with success. The Detroit Edison Company placed an order for another unit, making a third unit for the system. The manufacturers are the Paige-and Jones Chemical Co.

Cross-Examination by Mr. Cooper.

I am connected with a company that is making these commercial zeolite softeners. My company did not bid on this Detroit installation. I was acting for the manufacturer of the equipment that was installed. I acted for Paige and Jones. I am no in any way connected with them now. The equipment was installed during the summer of 1926.

Mr. Byron: Now, this is all the testimony which the defendant proposes to put in at this time, unless the question of the inoperativeness of the locked bed type of zeolite softener is raised in rebuttal, and if it is raised in rebuttal, then defendant wishes to reserve the privilege of bringing in some sur-rebuttal on that point.

268 The Court: Is that satisfactory to you?

Mr. Cooper: Well, I think not. If your Honor please, it seems to me that the defendant should put in its case so we can see what we have to rebut, and if our rebuttal goes beyond proper rebuttal, then it seems to me would be time to raise the question of sur-rebuttal.

Mr. Wilkinson: We don't care to take up the time of the Court in rebutting something that does not seem to have been raised at this time, but we don't wish to be foreclosed from putting on witnesses to prove the practicability of the locked type in case plaintiff in rebuttal does attack its practicability.

Mr. Cooper: I think my rebuttal will be strictly confined to an answer to the defendant's proofs.

Mr. Wilkinson: That would be an answer.

Mr. Cooper: Well, I think counsel understands me when he says that will be an answer to the defendant's proof.

The Court: I don't want to take any more time to hear this case than necessary because I have other matters ahead. I have counsel that have come 300 miles and have been waiting, and if I can eliminate and can shorten this testimony in any way, it is my desire to do so in favor of the other gentlemen. If you expect to go into that, plaintiff better offer their evidence now, if you don't there will be no use of doing so.

Mr. Cooper: Well, I think that is a very fair way of putting it. Suppose we let the matter stand. I don't want to say that witnesses won't speak on that thing, but whether it will be proper for sur-rebuttal or not is a thing that I don't

269 think I can foresee.

The Court: All right. I think both counsel wish to cooperate with me in that direction and I will try to be fair to

both sides, so if the issue arises both sides will have full opportunity to put in their evidence.

Mr. Byron: Just before we close, I want to make sure that all defendant's exhibits are in evidence.

Mr. Cooper: Well, I understand that all have been offered with the exception of two that were purposely marked for identification. One that I had in mind was Defendant's Exhibit 18 for identification.

The Court: What is that?

Mr. Byron: That is the letter in which the plaintiff apparently thought that an eighteen drop soap test showed soft water.

Mr. Cooper: That letter was not proven. There was a copy here. I mean, so far as it was put up to me it purported to be a copy, and I said I would look into that. Mr. Tiger is here and he knows the facts in respect to that, and if counsel desire they can interrogate him about it.

The Court: Does it purport to have been written by him?

Mr. Byron: Sales Department N. J. S., I judge. Oh, it is D. J. S.

Mr. Cooper: No, it was not Mr. Tiger who wrote it, but Mr. Tiger knows the facts in regard to that so far as the mere question.

270 The Court: It is not very material, is it?

Mr. Byron: Oh, not very material, no. It still has a point about what is soft water and what is not soft water.

Mr. Wilkinson: You are willing to admit, then, Mr. Cooper that this was written by the Permutit Company through D. J. S., the Sales Department?

Mr. Cooper: Well, I think it is a thing which, if it goes in, should go in with an explanation, so that the situation may be understood. There is no desire on my part to conceal the facts.

The Court: Well, I don't think it is going to have very much effect upon the Court's decision in this case.

Mr. Wilkinson: We understand you object to it?

Mr. Cooper: Yes.

The Court: It may be admitted, and if they desire to offer any testimony they may do so. It has been shown, has it not, that it came in the regular course of mail upon the letterhead of the plaintiff?

Mr. Byron: Yes, indeed.

Mr. Cooper: Hardly that. When it was shown to me it was simply a typewritten copy of a purported letter. I raise no question now, having never heard of it until the paper was

laid before me, but having inquired I may assume and do concede that it is a copy of a letter, although we have not the retained carbon copy here.

The Court: You do not have the carbon with you now?

271 Mr. Cooper: No, but we wrote the letter.

The Court: It may be admitted, and if the plaintiff desires to offer any explanation he may have an opportunity of offering it.

(Letter heretofore marked for identification DEFENDANT'S EXHIBIT 18 received in evidence.)

Mr. Cooper: Now, you asked generally about your exhibits. As I understand, all the rest are in, but I took objections, on which the Court reserved a ruling, as to certain of them.

The Court: Yes.

Mr. Byron: Just to make it a blanket proposition, if any exhibits have not been offered in evidence, I now offer in evidence Defendant's Exhibits 14 to 64, inclusive, and plaintiff's counsel may now examine the list of the exhibits, to see if he has any objections.

Mr. Cooper: I don't recall any more than I have already said.

The Court: Well, they may be admitted subject to the objections that have been heretofore preserved. That will protect your rights, Mr. Cooper.

Mr. Cooper: Yes.

(DEFENDANT'S EXHIBITS 14 to 64 inclusive, received in evidence.)

Whereupon the plaintiff to maintain the issues on its behalf, introduced the following evidence in rebuttal:

272 HOWARD L. TIGER, recalled, testified further as follows:

Direct Examination by Mr. Cooper.

Referring to defendant's exhibit 18 that has just been admitted in evidence I have knowledge of the facts in respect to the water that was under consideration there for the Gulf Refining Company's operation at Port Tampa, Florida. You showed me the letter yesterday. I wired for the analysis of that water, and I received that analysis.

Mr. Cooper: Now, may I put it in in that form? I don't

want to raise the question of a deposition to take the analysis of this water.

Mr. Byron: Certainly.

The Witness: (Continuing) The analysis showed that the well water referred to in paragraph 10, which I understand is the paragraph mentioned by the defendant, that's the paragraph in which the soap test nine drops in 20 cc is mentioned, the analysis of that water shows the following: total hardness expressed as calcium carbonate 700 parts per million. Alkalinity expressed as calcium carbonate 212 parts per million. Chlorides expressed as cl., 760 parts per million. Iron expressed as fe., 15 parts per million. Free carbon dioxid expressed as CO_2 130 parts per million. Turbidity 15. Color 150. That represents a summary of the analysis. In my 273 experience, water of that character can be softened by the zeolite softeners to a certain extent. When the water contains such a high amount of salts, these salts exercise a slight regenerating effect while the water is passing through the bed. In other words, they prevent the zeolite from absorbing all the hardness from the water so that the effluent instead of being completely softened is only partly softened. In such cases it is our practice, if we recommend softening at all, to state in terms of a special soap test that the quality of the effluent produced will meet with such and such a test. In other words, will meet with such a guarantee.

In this case 9 drops in 20 cubic centimeters represent the hardness which we would expect to have in that effluent after softening that water by zeolites. Now, with respect to the tests that have been referred to here of two or three or five drops, the quantity of water here is only 20 cubic centimeters instead of 40. So that test here would be reduced to 18 drops in 40 cubic centimeters. That would be a water containing some hardness; not a completely softened water.

Cross-Examination by Mr. Byron.

Zeolites, then, have limitations in so far as softening capacity is concerned.

274 FRED O. PAIGE, being first duly sworn on behalf of plaintiff, testified as follows:

Direct Examination by Mr. Cooper.

My name is Fred O. Paige. I live in New York City. I am President of the Paige-Jones Chemical Company.

I have heard the testimoney of Major Fritz regarding an installation of water-softeners at Detroit for the Detroit Edison Company. My company furnished those. My company is a licensee, a patent licensee under the patent here in suit.

Cross-Examination by Mr. Byron.

That is an up-flow type of water-softener, and I consider that to be a very successful type of water-softener. I consider it to be a better type than the down-flow.

275 EDWIN W. HAMMER, recalled as a witness on behalf of plaintiff, resumed the stand and testified as follows:

Direct Examination by Mr. Cooper.

I was one of those present at the exhibition of this Hawthorne apparatus here, Defendant's Exhibit 19, on the occasion when both defendant's and plaintiff's representatives were there in September last past. I watched the operation of the softener at that time, and then became acquainted with the construction of the apparatus. I am familiar with the Rundschau article. There are differences between this Exhibit 19 in its construction and operation and the disclosure of the Rundschau article.

I will state first what those differences are, simply cataloging or listing them, the Rundschau article disclosed a softener having a locked bed. The locking of the bed is dependent upon certain features of construction, in which the Hawthorne device differs. The Rundschau article shows a character of piping which is departed from in the Hawthorne apparatus. The Hawthorne apparatus uses a character of zeolite which is not disclosed in the Rundschau article. The Rundschau articel indicates a certain rate of operation which was greatly exceeded during the test which I witnessed. The up-rinsing

in the Rundschau device is not the up-rinsing practiced at Hawthorne. The Rundschau article speaks of a purification of the salt used for regenerating purposes and there was no purification of the salt used at Hawthorne. The Rundschau article indicates the necessity for proportioning the depth of zeolite to the conditions of flow and these specifications
276 were not followed at Hawthorne. That, in general, is a broad statement of differences.

In Defendant's Exhibit 40, at the left hand side of the sheet is a vertical section of the tank and among the features illustrated there is a flange ten inches from the top of the tank which is indicated as being three-sixteenths inch by one and one-sixteenth inch by two inches. I will indicate on this drawing before me that flange by the letter A in red pencil.

That flange is present in the Hawthorne structure. It is not shown in the Rundschau article, neither in anything approximating it, or capable of the same use, indicated in the description. In the Hawthorne apparatus, Exhibit 19, that supports and holds fixedly the two-part flat plate which is perforated at numerous points. I saw that plate removed from the Hawthorne apparatus while I was there. My recollection is that two men had to handle it.

Another feature is the rubber gasket which is in evidence and which was interposed between that perforated plate and the flange A of this diagram. That is not indicated or shown in the drawing or description of the Rundschau article. In addition to those features is the cloth which was substituted for the original cloth in the Hawthorne apparatus. That cloth is in evidence and is of the nature of burlap in the sense that it is a rather open mesh material. The fact that it is open mesh means that its resistance to the passage of fluid and whatever that fluid may hold is relatively small. It is a sieve of rather large mesh.

277 What the Rundschau article says regarding a cloth, speaking of the gravel and the Permutite bed is this:

"This is covered with a loose, uniform layer of fine excelsior which is held down by a divided perforated cover over which canvas is stretched."

Now, there was no canvas stretched over the plate in the Hawthorne apparatus. The cloth that was used was beneath the plate. There is, of course, a characteristic difference in the function of a cloth placed over the plate and one placed under it. It is placed underneath and pressure is brought

against it from below. It is held against the plate above it, and the only surface which is useful is the portion of the surface which registers with the cloth in the plate. If, however, the cloth be above the plate the entire area of the cloth is available as a medium for the flow.

In connection with the iron plate, the bed of zeolites and the cloth at Hawthorne there was used a certain amount of course excelsior. After the test the excelsior was gathered together and its cubic contents measured by merely putting the excelsior in a can and the cubic contents of the can measured. If we refer to Defendant's Exhibit 40 at the center of the righthand portion of the sheet there will be seen a diagram illustrating a distribution of various materials presumed to be employed in this apparatus at Hawthorne. Among the items is a vertical depth of excelsior of four inches. The fact was that there was a space of four and one-sixteenth inches between the plate and the bed of the zeolites and a calculation of the space represented by that depth in that
278 container was a number of cubic inches almost six times the amount of excelsior we found in there. In other words, the instructions of the Rundschau article with respect to the excelsior were not followed. In the first place, it was not a uniform layer, in the second place it was not held down by anything. The general conditions are indicated in four little thumb nail sketches which I have drawn free hand, two of which illustrate my conception of what happens in Rundschau when you have a plate which holds down the excelsior and the two other little diagrams illustrate what I saw to be the case at Hawthorne. These diagrams show in Fig. 1 an amount of excelsior with a plate free to move, resting upon it, and in Fig. 2 it shows that excelsior under a condition where due to wetting or compacting or otherwise the follower plate simply follows and still rests upon and holds down the excelsior. This is a condition which is prevented in the construction at Hawthorne as indicated in Fig. 3 where a falling of the excelsior upon the withdrawal of fluid, for example, leaves the space which is indicated there above the excelsior and between the excelsior and the plate, whereas when the apparatus is in use and water is being softened or where a rinsing flow is going upward, the boiling of the zeolites followed the excelsior upward against the plate, leaving the grains of zeolite free to dispose themselves in accordance with the general law effecting such matters which will bring the light particles to the top.

279 At Hawthorne there was a definite boiling as stated with a rocking of the bed. It was observed by me that the bed rose, that the excelsior rose, that the cloth was pressed upward against the plate and when the device was dismantled and the zeolites examined it was apparent then, as it is now, upon an examination of the samples of the zeolites in court that the zeolites and the excelsior had come in violent agitation to the extent that the excelsior was largely mixed in it and to some extent imbedded in the bed of zeolites, even to the depth of six inches in that bed.

(Sketch prepared by Mr. Hammer received in evidence and marked PLAINTIFF'S EXHIBIT I.)

The Witness: (Continuing) I will mark on Exhibit number 40 at the right hand side of the page, the four inches of space for the excelsior with the letter B in red pencil. The very definite and intended rigidity of location of the upper plate in the Hawthorne apparatus is indicated by the fact that the flange not only holds the plate and supports it away from the excelsior, but that bolts are used to fixedly attach the plate to the flange and to the cloth and to the interposed rubber gasket.

I have found in the Hawthorne apparatus at the bottom of the pipe which passes through the center of the bottom of the apparatus, there is a coupling welded to the lower plate of the tank, which has four holes in it, each about a quarter of an inch in diameter, as indicated in a diagram on Defendant's Exhibit 40, about the center of the page, and to the left of the center. I have marked this feature, which is designated, "Bottom connection" with the letter C in red pencil.

280 I find no justification for this construction in the Rundschau article. Certainly there is no instruction that these holes be employed. Such instruction as there is in the drawing of Rundschau is against this assumption of holes at that point. I do not assert that holes could not be used there. I do assert that the showing in Rundschau is not a showing of holes either graphically or as a matter of description. Such showing as there is in Rundschau is rather against an assumption that these are holes rather than a demonstration that they are.

As appears from the diagram in the Rundschau article and as indicated in the text, the flow of water into the tank is upward through the central pipe at the bottom and is then distributed through the various headers of the horizontal system in the bottom of the tank and that then the water is uniformly distributed through the plate above it and through

the zeolite as indicated by the arrows. There are no arrows indicating any flow from any other point.

Another factor is this, an examination of the drawing, even a magnified drawing, shows those two little dots which Dr. Moses has assumed to be holes to be round and not square as would be the case if the draftsman were indicating a hole from the outside to the inside of that pipe, and it may be also observed that a dot in the center of the pipe at that level is so shaded that it would not be a representation by a draftsman of a hole but rather of a projections.

281 So that my general conclusion is that in the absence of any description of that particular feature, and in view of the possibilities that the two dots may be cores in the casting or may be anything else except a hole from the outside to the inside, and in view of the other circumstances to which I have referred, we are not justified in concluding that those particular dots are holes from the outside to the inside of the pipe. And that idea may be carried a little further by observing that in some other parts of the casing there are similar dots which obviously are not holes and which are merely imperfections in printing.

The Hawthorne apparatus was quite elaborately piped, and in that respect differed materially from the simple piping of the Rundschau article, which shows a pipe to admit water at the bottom of the tank and to permit a withdrawal of fluid and also a pipe at the top for the admission of brine and also a system through which the water passes in its way out. The Hawthorne apparatus had these things, but it also had more and the principal differences in piping and the additions were additions of quite a material character, as it appeared to me. One of these differences lay in the construction of a second outlet pipe as represented by the pipe coming out at the left of the opening as the tank stands now in the court room, that outlet having a valve upon it and running into the same pipe which takes water from the header system at the top of the tank.

282 When we came to the mode of operation of the Hawthorne apparatus, I found several differences from what is taught by the Rundschau article.

The principal difference in operation lay in the fact that the rate of flow through the tank was more than three times that indicated in the Rundschau article, which calls for 18 gallons per minute, whereas the Hawthorne device ran in the neighborhood of 60 gallons per minute. It may be quite true that the tank under the conditions used at Hawthorne had the

greater capacity, but in forcing it to a greater capacity there was a different condition set up within it from that which would have been found had the conditions of structure and operation been the conditions we used. Understanding that, there was this great space, vacant space, between the top of the zeolite bed and the plate, and understanding that this upward rate was three times as great as the Rundschau article contemplated, it is of course perfectly understandable that the bed must boil and did boil.

During the operation of the apparatus at Hawthorne I was careful to observe what was taking place beneath the plate by delving down through the holes in the plate with a pencil and by watching what was happening in the way of bubbling and general agitation, so that I can assert the fact of bubbling in that tank and assert the fact that the bed was not a locked bed as used.

If the depth of zeolite in the Hawthorne tank was the depth contemplated by the Rundschau article, and I believe it was, a depth of zeolite adapted, according to Rundschau, for a flow of 18 gallons per minute.

The Rundschau article says:

"The depth of the Permutit layer is dependent on the rate of flow of the water and its hardness and is determined by experience."

And then it gives the basis, based upon this experience, and the figure is the figure of depth of the Hawthorne and the rate is one-third the rate of Hawthorne.

In my judgment, with respect to this exhibit 19, if the tank had been changed to the construction which I have said was in this Rundschau article to the extent of removing this angle iron piece and letting the heavy perforated plate above it rest down upon the excelsior, that would have been a substantial difference in the condition and operation within the zeolite bed; and markedly so, if the rate of flow contemplated by the Rundschau article had been utilized.

One factor indicating the use of an upward flow not contemplated by the Rundschau article lies in the fact that when the canvas originally employed had been in place, a flow of 18 gallons per minute had been secured; and that when the extra flow of substantially 60 gallons per minute had been decided upon, it was necessary that the piping provided by Rundschau should be supplemented by something else having a much greater individual capacity.

Another feature of difference in mode of operation comes about from the fact that in the test which I witnessed,
284 while the brine was in the tank and we were waiting for regeneration to be completed, six pailsful of brine were drawn from the bottom of the tank at ten minute intervals and poured in at the top of the tank, one pailful at each interval. This is something which is not disclosed in the Rundschau article and which I understand is asserted to be an extra difficult test of the performance of the device and an unnecessary test because what the article states is not that.

What the article states is this: That after the brine has been run into the tank, "This is allowed to react with it for about six hours, with intermittent draining through valve I, and subsequent return through the filter." There is nothing said about ten minute intervals. There is nothing said about two and a half gallons and there is nothing said about pouring it in at the top.

And in connection with the latter statement it must be remembered that one feature of operation is to withdraw fluid the bottom of the tank and then force it in again through the same opening so as to get an up and down pulsation action of that fluid in the tank.

There is nothing said about taking these small samples and dumping them in at the top. I don't know exactly what the Rundschau article means because it is not entirely clear, but it certainly does not give the justification for taking six pailsful, and only six pailsful, and at intervals, and at ten minute intervals, and pouring those two and a half gallons at a time into the top of the tank.

285 As the result of my examination of this Hawthorne apparatus and in summation of the differences I have pointed out, in construction and operation, I do not consider that it is a substantial embodiment of the Rundschau article.

Cross-Examination by Mr. Byron.

286 Q. I consider that all articles of a technical nature and all patents are addressed to those who are skilled in the art; from the patent suit standpoint.

A. Yes; I should say that is about correct of technical magazines, magazine articles, technical magazine articles. The words "Technische Rundschau" indicate to me that the Technische Rundschau magazine is a technical magazine; it is devoted largely to technical matters. I think it may be as-

sumed that an article in the Technische Rundschau is addressed to those skilled in the art.

Mr. Byron: Now, is it the object of one skilled in the art to observe a machine or device disclosed in the article with the thought in mind of making that article or device a failure or giving words their ordinary interpretation with the thought of making it a success?

Mr. Cooper: I think, if your Honor please, that is uncalled for and decidedly improper.

The Court: Oh, he may answer.

A. I think any intelligent engineer would try to find out honestly what the device meant and the conclusion that he reached would depend upon the state of knowledge of his period and the state of knowledge which he individually might have.

Mr. Byron: Q. What would an intelligent engineer do to drain a casing if that casing were a large heavy elevated casing?

287 A. It would depend entirely upon the result which he wished to attain and whether it was necessary or desirable to remove all of the fluid from the tank or just enough to permit a recurrence of a definite thing.

The Witness (Continuing): I ordinarily mean by the words "draining a casing, not usually drawing out, for example, a pail full at ten minute intervals.

Asked what I think draining means as draining a casing for example, draining the case in the device of the Technische Rundschau article, I should say that for ordinary purposes that tank would be drained if the fluid had drained out through that header system into the sewer.

Q. Please answer my question and tell me, or inform the court, what you think the words "draining a case" mean.

A. Cutting—

Q. Let's not get into little difficulties. Let's be perfectly frank with each other. You are intelligent and so am I.

A. I have known of tanks which have been drained without all of the fluid being removed.

Q. Well, how much would be drained then, from your point of view?

A. All that was necessary to be taken out.

Q. Well, how much is necessary to be taken out?

A. In this case all the fluid down through the header system.

288 Q. Well, now, I am just going to keep at this if it takes all night to find out what draining a casing means. I don't think you should take up the court's time in this way, but that you should answer the question and be perfectly frank about it.

A. I will be perfectly frank and say there is more than one interpretation that may be given to that and one explanation would be to take out the very last drop, which is not a necessary concomitant to the use of that term.

Q. What do you believe the word "draining" means as applied to draining a casing?

A. The taking out of such fluid as is required in order that the desired result may be secured.

Q. Well, just take the plain old style tank without any—

The Court: What does it mean to drain a bathtub?

A. Yet the water out.

The Court: Yes, sir. Now go ahead.

Mr. Byron: Q. Is there anything in the Rundschau article which says you shall take out more than six pailsful or less than six pailsful?

A. No; it says it is drained.

Q. It is left to the judgment of somebody who has some intelligence, is it not?

A. Presumably it is.

Q. Addressed to those skilled in the art?

289 A. Yes.

Q. Is the Rundschau device provided with a little auxiliary device, a plunger, for shooting the salt back into the lower opening?

A. I don't know of any.

Q. Well, do you see any?

A. No.

Q. Is any described?

A. No.

Q. Well, then, how would you, as an intelligent man, put some brine back into that casing?

A. If I wished to do what is contemplated by the question—

The Court: Read him the question Miss Reporter. And then you answer the question as put to you, sir.

A. I would use a pump.

Mr. Byron: Q. You would use a pump?

A. I would use a pump, which would drain the tank and then permit that to go in the reverse direction to reenter the

tank. It would be a suction and a return through the same channel.

Q. We are out on the Sahara Desert now, without any pumps, and we have that tank full of water and we want to drain some of the water out of that tank and put that drained water back into the tank. Now, how would you do that as an intelligent ordinary man?

290 A. It would depend altogether on what I did have to do it with.

Q. Well, you have your hands and a bucket or your hands and your hat.

A. Yes. Well, I would use such instrumentalities as I had for doing the same thing.

Q. Do you think possibly you could get some of that drain solution back into the tank without a pump?

A. No doubt about it at all, sir.

Q. You could do it?

A. No question about it.

Q. What would be the natural way of doing it?

A. It would depend on the result you wanted to accomplish.

Q. The result you want to accomplish is to get water back into the tank? What is the natural way of doing it when the tank has not been tapped?

A. If you had no other means to do it, this pail, but you are not limited to that by any manner of means, and that may not accomplish what you are after.

Q. Do you gather from the Rundschau article that a pump should be used?

A. I do not know what it discloses in that respect.

The Court: Oh, he didn't ask you that.

The Witness: No. I don't know that it says a pump or indicates it.

291 The Court: You said no. Just answer his questions and then go along.

Mr. Byron: Q. Now then, if there is no pump to put the drained liquid back in, how would you, as a natural man, or plain intelligent man, put the drained water back into the tank?

Mr. Cooper: I think that has been answered, your Honor, two or three times.

The Court: I think so.

Mr. Byron: Where in the Technische Rundschau article do you find that the plate,—and I refer to this cover plate to which you referred as requiring two men to lift out of the de-

vice,—where in the article do you find that it is a metal plate or a wooden plate or a cork plate or a plate of any other material?

A. It is a plate which shall hold down the excelsior. There is no statement as to what it is made of.

Q. Precisely so; and that does it, does it not?

A. No.

Q. Well, is it your opinion that water being forced up through this casing would force the excelsior out of the casing and beyond the cover?

A. No; it permits the excelsior to rise and not come out through, but it rises from the top of the bed.

Q. It prevents that excelsior from rising up above the plate, does it not?

A. Yes.

Q. It holds it down in that respect?

A. Yes; in that respect.

292 The Witness (Continuing): Referring to this article, I refer to the depth of Permutit also being dependent on the rate of flow of the water and its hardness as determined by experience, so this article leaves something to determination by experience. The article says the upflow softening rate was 18 gallons per minute. Experience has taught us through this large period of years, something more than was known at the time of the Rundschau article; we find that this device is capable of softening water at a higher rate than 18 gallons per minute.

Q. Then experience with the Rundschau device shows us that that device was far more efficient from a water softening point of view than they realized at that time; was possible; is that not correct?

Mr. Cooper: That is purely argumentative.

The Court: He may answer if he knows.

A. As used in a different manner from that described in the paper.

Q. As used in defendant's exhibit 19?

A. Yes.

The Witness (Continuing): I stated that with a 60 gallon rate of flow, the zeolites were circulating beneath the cover. That could be determined by observation both of what was visible to the eye and what was determinable by delving down into that space. The grains of zeolites were not pressed up against the cover, as a bed, but the zeolite grains were circulating up in that space. They were in a semi-suspended con-

dition there; there was a levitation there that was apparent.

293 This Rundschau article calls for a uniform layer of fine excelsior, and it states this cover, this uniform cover of fine excelsior is to be loose, that is the term that is employed in this translation. By loose I would understand it to mean porous. In common ordinary English the word "loose" means not compact. When water flows upwardly through the bed of zeolites and it encounters loose excelsior, the excelsior will have a tendency to become compact. If we had four inches originally of loose excelsior and that excelsior became packed as a result of pressure, then there would be some free space in between the plate and the top of the bed, unless the plate held it down against the bed. The result of dry excelsior becoming wet is that it would become more compact, this is compensated when you use the follower plate as distinguished from the supporting plate.

The word follower plate is not used in the Rundschau article but the statement is made that the excelsior is held down, and that can only be done if you have a plate which is free to move. The excelsior immediately below the plate is not bobbing on a body of water, but taking your assumption that it is bobbing on a body of water, then, as that water rate is increased, the bobbing up of the excelsior will get a little bit more and a little bit more and a little bit more, the excelsior might possibly engage that plate. The plate will compact the excelsior more. It will prevent it from rising any further, we will say that. Because that is not what the Rundschau article says. It says that it is held down and if it is held down it can only—

294 I find no statement in the Rundschau article about a locked bed, except as the bed is held down by the plate.

Water will certainly run through square holes as well as through round holes, when they are in the right direction. There is no discrepancy between the drawing of the Rundschau article, which shows arrows pointing in the direction of water and another drawing with the same pipe which does not show arrows to show the direction of the water. All of the openings shown in the Rundschau article drawing do not have arrows to point the direction in which the water is flowing.

Mr. Byron: It is stipulated,

"That defendant's exhibit No. 26 hereto attached is a true enlargement of the drawings appearing in the Rundschau article in Technische Rundschau."

Q. I believe that Mr. Waterman stated yesterday that any

space below the plate which is free space to the extent of ten per cent of the total voulme was a locked bed; is that correct?

Mr. Cooper: Are you speaking of what Waterman said? Because I did not so understand. However, I have no objection to asking Mr. Hammer his understanding of the statement.

Q. Well, what is your statement about its being a locked bed?

A. I did not hear precisely what Mr. Waterman said.

Q. What is your idea about it?

The Witness (Continuing) My idea is that if he made such a broad statement he was mistaken, because that is not
295 my idea of what a locked bed is at all.

My idea of a locked bed is very definitely one which is, by reason of its surroundings, prevented from so changing its shape or form or dimensions as to prevent a re-adjustment of the particles of the zeolites in stratified layers according to their size. Of course, if that is prevented, certain things flow from it but, broadly speaking, any bed is locked which cannot move; and that is the difference between a free bed and a locked bed, one is free to move and the locked bed is not. My view of a locked bed is where a plate is right down square on top of the surface so there is absolutely no pulling action of the zeolites, that or its equivalent, so the bed is prevented from boiling and re-arranging its grains.

I stated that the zeolites and the excelsiors in the Rundschau device tested at Hawthorne were mixed to a depth of six inches; that did not, as used, affect the efficiency of the Rundschau device in softening water; it did not affect the efficiency of the Rundschau device in the regeneration of the zeolites; it would not affect the efficiency in any water softener wherever it may be used. I stated that the excelsior used in this test in question was not a uniform layer. I would be inclined to say that my definition of a uniform layer of excelsior was a layer of uniform thickness and density. A layer may be placed in relatively uniformly and as a result of the boiling action it may become nonuniform. When the plate was taken off I found that the entire bed of zeolites was covered with excelsior but covered at different depths,
296 different thicknesses. Yes; I should say there were differences of 50 per cent. I can't say definitely what the variation in thickness of the excelsior layers was, but I can give you the general idea that it varied from an inch to two inches or a little more.

There would be a difference in function of coarse excelsior

and fine excelsior in a device of this type; the finer the excelsior the greater resistance to flow and also to movement of grains. As indicated by the Rundschau article the function of excelsior in this type of softener would be to hold the grains down in place against movement. This excelsior which was used is termed coarse excelsior. I did not think that any of the zeolites were washed away in the test. This excelsior was not successful in performing its function; I should say whatever perfection there was in that respect was due to the burlap rather than to the excelsior.

I stated that this cloth was very coarse and had large openings in it. I doubt whether we would be apt to find that grains of zeolite could get through those openings. What you are showing me is a tear, two inches in diameter; a grain of zeolite could get through that. I did not observe that any had gone through when you removed the cover. Referring to my expression, "The cloth being over"—I apprehend that there are two ways in which canvas can be drawn or stretched over a plate. One is to put it on top and the other is to put it in as you would put a pillow slip on a pillow. I mean to say, that it would be over it if it was under it.

297 If you were going to use a screen, a common old ash screen, the screen would be placed underneath, and you would still say it was stretched over the hoop or frame, if that was the fact; because a stretching over would be the function not of the position of the frame to which it was attached. The function of the cloth in the Technische Rundschau article is to limit the flow of fluid and to assist in restraining the movement of the grains.

I think there is no doubt that the cloth was really put over there to hamper the flow of water that is trying to flow through there. I don't know whether water is to be passed through there with as little pressure as possible, to prevent pressure loss. We are told that you are to get 18 gallons a minute and it was a rate which was first found to be possible with that apparatus.

I see no reason why a man skilled in the art would not try to hamper the upflow of water if by doing so he wanted to accomplish something else, that is the restraining of the bed and the prevention of loss and circulation of the grains. Not to prevent a pressure, loss, but to prevent this movement and loss of grains. That can be done in a degree by a coarse cloth as well as a fine cloth. If you want 18 gallons a minute and you had too much pressure on the outside grains one would use a fine cloth to hamper the upward flow of water. One

skilled in the art, if he wanted a definite flow for a definite purpose, he would try to hamper the operation of his device by putting on a cloth which would prevent the ready flow.

298 Mr. Byron: Now you and I understand definite flow and definite purpose. We will take a definite flow and call it X and a definite purpose of the flow is to pass the water, pass the zeolites, soften them and get them out of the casing. Now, with that understanding will a man skilled in the art, an ordinarily intelligent man, place in the path of that water something which is going to prevent that flow?

A. No; but if he wants to regulate it he will.

Q. Well, I am not talking about a regulation. Just without regulation, what is your answer.

A. I have no answer.

Q. You will have the court to understand that is the best you can do?

A. Why, certainly.

The Witness (Continuing): If the cloth had been placed over the plate instead of under the plate, there would have been no difference in so far as the softening of water is concerned. The use of a rubber gasket did not affect the softening function. It did not affect the regenerating action. It did prevent possible leakage around the edge, which was definitely prevented by using this gasket and holding it down there, that prevented this bubbling up around the edge that was observed. I don't know why anybody should do it. It was not contemplated by Rundschau. Yes, ase one skilled in the art, if I wanted to seal an edge, I would use rubber or something else of that nature.

299 I understand the word Permutit is used generally to mean a basic exchange material, one that exchanges sodium for calcium and magnesium and vice versa. Zeolite comes under that classification. When the Rundschau article refers to Permutit and therefore zeolites, with our understanding it does not state what kind of zeolites shall be used. The function of the zeolite back in the Rundschau day was not different from the function of the zeolite in this present day, as a general function; as a quantitative matter it was a different thing. That is to say, I am of the opinion that zeolites are more efficient today than they used to be.

Mr. Byron: And isn't that one reason why you could soften water more readily with this present day, with the Rundschau device as used with present day zeolite instead of the zeolite of the day of the Rundschau article?

Mr. Cooper: Well now, I object to the form of the question

because it contains an assumption which the witness has not testified to, that this device here is a Rundschau device. Do you identify that?

The Court: He may answer.

The Witness: Without doubt that is true.

The Witness (Continuing): I regard the zeolite which was used in this Rundschau test as different from the zeolite that is referred to in the Rundschau article; my understanding is that Decalso or its equivalent, was not known in 1909, but that other forms of zeolite were known and were used at that period. It would be possible to obtain zeolites of the
300 same character that were made back in 1909 or 1908. That would function the same, qualitatively, as the zeolite did in this test; quantitatively, no. But it would function to soften water. It is only a question of how much water it would soften and the rate.

I did not hear Mr. Waterman mention flying exchange and I do not know what he means. The exchange of zeolites from calcium and magnesium to sodium is a quick change. I understand you to say that is what he meant by a flying exchange. The zeolites in the early days, the Rundschau days, had that capacity for a flying exchange; just exactly the same as the zeolites today but there is a difference there which could be explained.

With respect to this additional pipe connection it did not affect the softening operation of the zeolites nor the regeneration of it; it determined the rate at which it should be done. Pure salt would really act better in regeneration than ordinary commercial salt, I should say that in regenerating the Rundschau device, that is, defendant's exhibit 19, with common commercial salt, we were doing it somewhat to the disadvantage of the device; but in spite of that fact it functioned very well.

The increased rate of softening from 18 to 60 gallons per minute indicates the superiority of the operation of today over that described by the Rundschau article.

I have referred to about seven differences between the disclosure of the Rundschau article and the corresponding
301 device softener which defendant has produced, and which is known as defendant's exhibit 19, other than this question of a locked bed none of those other items affect the softening action of the water by the zeolites or the regeneration of those zeolites. I consider the device of the Rundschau article, a locked bed. And on the basis that it is a locked bed, it is not my position that it is inoperative, it will work a certain

length of time and ultimately fail in utility, depending on circumstances, the character of water that is used with it and the mode of operation. I don't know how long it would operate using the ordinary reasonably clean water. I have a basis for my statement that it would not operate any length of time. It is based upon the knowledge that a locked bed definitely acts as a mechanical filter; that it will develope the formation of channels through which the fluid will pass, such channels becoming progressive and rapidly exhausted so far as their softening characteristics are concerned, and that unless there be a cleansing and a rearrangement not possible with the locked bed, the natural softening qualities of that bed will be nullified and it will no longer be possible to use that device as a water softener.

A downflow water softener having a screen at the bottom of the bed of zeolites is a locked bed, that is, the bed is locked when the water is passing downwardly through the bed. It will soften under those conditions, until the bed becomes dirty and needs to be revived by a back-washing and boiling.

302 If the water is filtered before it ever goes into the downflow softener, then the bed would not operate forever in so far as dirt is concerned. The answer is that under those conditions and after a time the downflow water makes for its channel which are easier for the flow than other sections of the bed and the walls of these channels will become depleated so far as softening capacity is concerned after a time, and will no longer function, but that an upflow with a redistribution usually, and a cleansing, if cleansing is necessary, will restore the pristine condition. It would not be possible to regenerate satisfactorily a down flow softener with its bed locked below and without any movement of the bed on top; only to an extent.

No; I do not know that there are truly locked beds in accordance with that definition which are in actual use, and on sale today.

Redirect Examination by Mr. Cooper.

When they took this piece of cloth out of Exhibit 19, on the day of the demonstration it is my recollection that I saw some holes there. I do not know how many or which holes.

When the two men took the two part perforated plate out of the top of this casing in 1929, I personally made some measurements, I found that there was a depth or a distance of

4.16 inches to the bed of the zeolites from that flange, and that there was a difference or a depth of excelsior varying
303 from an inch to two inches or a little more, that is measuring the depth of excelsior from the zeolite bed up.

Recross Examination by Mr. Byron.

The excelsior that was packed into that can was wet, as it was taken out of the bed. You can compact wet excelsior much more than dry excelsior.

304 HEINRICH KRIEGSHEIM, a witness called on behalf of the plaintiff in rebuttal, having been first duly sworn testified as follows:

Direct Examination by Mr. Cooper.

I live in New York. I am President of the Plaintiff corporation. I was born in Germany; I lived there until 1914. I came to this country in connection with the development of the plaintiff's business. I have remained here since, except for visits. I was technically educated in Germany; at one time I was connected with a firm or business there known under the name of David Grove; from 1903 until 1910. The business of Grove had a number of departmets, heat and water supply, water installation. I was the chief of the department over water supply and sewage disposal. I got in charge of the water supply of Grove in 1903, when I entered the service there; I remained there until 1910, in charge of that.

During that period I came to know a concern under the name of the J. D. Riedel Company, Berlin. My home was in Berlin.

I knew a periodical designated The Technische Rundschau; it is a weekly edition to a newspaper the Berliner Tagblatt.

305 In connection with this Grove business I have described, I came in contact with the question of water softening by zeolite. It was in the year 1907 when I read in the paper an article by Gans. The paper was the Chemiker Zeitung. I did not understand that article quite completely and therefore I went to Riedel and asked about it. The article referred to Riedel and I went to him. I could not get satisfactory information, and therefore I went to Gans, to

Professor Gans. Professor Gans was the inventor of these silicates which Riedel manufactured and which were mentioned in the paper, in the Chemiker Zeitung, as a means for purifying the water.

The Riedel Company had taken out or took out about that time the name Permutit as a trade name given to the Riedel Company's product of these silicates. It has continued as far as I know as a trade name of the exchange silicates manufactured by the Permutit people—by the Riedel people.

I investigated this Riedel matter and I met Gans. I ascertained there was a contract relation between the Riedel Company and Gans. The Riedel Company had manufactured silicates and they made experiments to use them for practical purposes, and they claimed it was a failure. I investigated further to find out whether it was a failure, that was the reason I went to Gans, and Gans blamed the Riedel Company for its failure. Gans then came to our office repeatedly and asked for information on constructive details for filters, for tanks, pipe connections and so on.

306 Q. Subsequent to this did there come a time when your Company—that is your then company—Grove, built something for Gans?

Mr. Wilkinson: Your Honor, this is entirely foreign to anything in this case, and I object to this line of examination.

The Court: Objection sustained.

Mr. Cooper: If the court please, this is of course purely preliminary, and leading into articles that have been offered by the defense.

The Court: Objection sustained to those questions. They do not touch this case, top, side nor bottom. I do not care whether they are preliminary or ultimate or what they are.

Mr. Cooper: An article has been put in here by the defendant known as the Weiss article and referring to a Glogau installation. Are you familiar with the Weiss article?

A. I am.

The Court: Weiss article?

Mr. Cooper: Yes, your Honor. That is the one of 1910.

Q. You are familiar with that?

A. I am, yes.

Q. Does that Weiss article describe a water softening thing?

A. No.

Q. What does it describe?

307 Mr. Byron: Tell us exactly what it does describe. That is the best evidence.

The Court: They speak for themselves.

Mr. Cooper: I am simply trying to get him to explain one or two details that I want.

Q. What was that Glogau installation used for? Were you familiar with that?

A. Yes, I was. The Glogan installation was for the purpose of the removal of manganese from water.

Mr. Wilkinson: This publication, as you suggest, speaks for itself, and I object to the examination of this witness as to his understanding of what these articles were.

The Court: Sustained. I do not care what this witness or anybody else thinks these refer to. I have to determine that for myself.

Mr. Cooper: Your Honor, I am not intending to go any further.

The Court: Why ask him what it means? I have a dictionary at home and an encyclopedia in the library, and law books.

Mr. Cooper: Q. Was there subsequently to these matters between Gans and you about which you have testified, was there subsequently built up a business in Germany under the Gans matter?

Mr. Wilkinson: I object, your Honor. It is wholly immaterial to the issues in this case what was done over in Germany.

308 The Court: Objection sustained.

Mr. Cooper: All I can do, if your Honor please, is to make an offer to prove that this business in Germany was based upon the Gans disclosure, and that subsequently this witness came over to the United States, and upon those disclosures and on the basis of the patent here in suit started the Plaintiff's business here, and that was the point of my calling this witness.

The Court: That is true, but there is one question involved here, and that is the validity of the Gans patent and whether it is infringed. I do not care how long he has been in business, I do not care how he happened to get into it. The only thing I am interested in is whether the patent which he relied upon in making the produce, is a valid patent.

Mr. Cooper: I am bowing to your Honor's ruling.

The Court: I do not care about all these years of experi-

ence that he has had in his business or that somebody may have had elsewhere.

Mr. Cooper: I am bowing to your Honor's ruling. I am simply making, under *Blease* v. *Garlington,* and under the equity rules, an offer to prove.

The Court: What do you want to prove? Why offer to do something that does not touch this case?

Mr. Cooper: I am offering to prove by this witness that these disclosures of these articles—

The Court: What disclosures?

309 Mr. Cooper: The disclosures of the Rundschau article, the disclosures of these Gebrauchsmuster patents were in fact inoperative.

The Court: That is not what you are attempting to prove by him. Your questions do not bear any relation to that so far.

Mr. Cooper: I am simply laying the foundation.

The Court: If you offer a proper question upon that subject, I will hear it.

Mr. Cooper: Q. Are you familiar with the disclosures of these Gebrauchsmuster patents that have been put in evidence here by the defendant?

A. I have esen them.

Q. Did you investigate at the time the devices which are represented in those articles in Germany?

A. I saw some of them yes.

Q. Did they operate or did they not operate, in a commercially satisfactory manner?

Mr. Wilkinson: Your Honor, I object to this. It makes no difference whatever whether over in Germany they operated or they did not operate. That has no pertinency whatever to the issues in this case. The articles speak for themselves. If those articles comply with the requirements of the United States Patent Office, they are not added to or detracted from by anything done over in Germany.

Mr. Cooper: I want to show whether the disclosures of these particular things on which the defendant relies, whether they would work or not work.

310 The Court: I do not understand the defendant to rely upon prior use in Germany at all. As to anticipation, I do not understand you to rely on that.

Mr. Wilkinson: Not at all.

The Court: If so, it is my duty to overrule them.

Mr. Cooper: I am not putting that question.

The Court: You are asking as to the prior use, whether they were commercially successful.

Mr. Cooper: Whether they worked or not as disclosed here.

The Court: Well, if they did work it would not anticipate your invention, would it, your patent?

Mr. Cooper: According to the defendant it would.

The Court: No, not according to the defendant.

Mr. Cooper: They have set up here and argued to your Honor that there was no invention in view of these very things that I am inquiring about.

The Court: The disclosure, as I understand it.

Mr. Wilkinson: That is it exactly.

The Court: The state of the art as shown by these things; not as anticipation. Is that right?

Mr. Wilkinson: That is right. Certainly we could not rely upon a foreign use.

The Court: The question is whether this patentee, reading the disclosures that have been made, could have, with the exercise of ordinary mechanical skill, made what he made, or was it invention for him, with the art as it then existed, so whether these things worked, I take it as wholly immaterial.

311 Mr. Cooper: I beg to differ with your Honor.

The Court: Do you understand that the defense has offered any evidence of any of these things working in Germany, as evidence of anticipation?

Mr. Cooper: No, your Honor, I do not think you get my point at all. What I am offering to prove, and what I understand your Honor is ruling out, is proof to show that these devices were inoperative, all these disclosures on which the defendant relies, and that the mechanics and inventors at that time spent a long period before Gans solved the problem. That is my offer of proof by this witness.

The Court: Suppose they did.

Mr. Cooper: Your Honor ruled against me, and I have made my offer. There is only one other question I have to ask the witness.

The Court: Let me ask you a question.

Mr. Cooper: Yes, your Honor.

The Court: Suppose they did this, suppose these gentlemen did attempt to get a machine to work, suppose it worked, would it be any defense of anticipation, what happened there?

Mr. Cooper: No, not as such.

The Court: There is just one thing here that this evidence of what was done in Germany is competent for, as I understand it, and that is to show the state of the art. Isn't that right?

Mr. Wilkinson: The publications you mean?

312 The Court: Yes.

Mr. Wilkinson: Yes, the state of the art, and as anticipatory.

Mr. Cooper: Your Honor has admitted the evidence of two young men, both of whom graduated from college after the date of this invention, who testified, one of them with respect to each of these documents that I am now having under consideration, that anybody could make a commercially successful device from that disclosure. I am endeavoring to show that contemporaneously with those disclosures the utmost efforts were used by large interests in Germany, and that they failed to make a commercially successful device until Gans made the invention of the patent in suit.

Now that is the issue, I have tendered the evidence and your Honor has ruled agaist me.

The Court: Well, I have asked you a certain question.

Mr. Cooper: Of course.

The Court: I asked a question and I expect you to give me such aid as you can.

Mr. Cooper: I am giving you all the aid I can, but I am not pressing the matter beyond a tender of evidence.

The Court: I will let him answer subject to your objection, gentlemen. If he knows. I do not care to have any hearsay testimony as to whether somebody tried to do something and failed, but if he were personally present and knows what transpired he can testify to it. If he does not, he may not.

313 Mr. Cooper: Q. Do you know about efforts to use the devices disclosed in those two Gebrauchsmuster patents?

A. These two?

Q. The two Gebrauchsmusters?

A. I never saw the apparatus of these conical Gebrauchsmusters which are here. There are three or four, I don't know exactly.

The Court: Two in evidence, aren't there?

Mr. Cooper: Q. Now with respect to this Gebrauchsmuster 313,617, which it has been testified is identical with Feldhoff's article, were you acquainted with efforts to use devices like that?

The Court: Did you see the machine?
The Witness: Yes.
The Court: Were you present, and did you see an attempt to make use of it?
The Witness: Yes.
Mr. Cooper: Q. With what result?
A. It did not work. It gave some soft water but it did not give sufficient water. It gave low and high results. It varied continuously.
Q. Were the beds they attempted to use investigated in your presence?
A. Yes.
Q. By whom?
A. By Gans and his chemists.
Q. And you saw the condition of the beds?
A. Yes.
314 Mr. Wilkinson: Just a minute. This witness is testifying about events that occurred a long while ago, and it is a different thing from the examination of experts. I will ask that counsel do not lead this witness.
Mr. Byron: That was twenty-two years ago.
Mr. Cooper: Q. Describe what you saw when the beds were opened at the time of this investigation.
A. Such an apparatus similar like that was installed in the Riedel factory, and we visited said apparatus, tested it, and opened it, and when we opened it we found that, removing the upper plate *b* the excelsior was matted together closely, was full of air bubbles and dirt. There also was some fine silicates in it. And then the layer *c* also was cemented together to balls, what we call mud balls, and air was in it. Sometimes they took samples, investigated them, and found that the zeolites in the middle of the—
The Court: Did you do this yourself?
The Witnes: No.
The Court: That is what somebody told you?
The Witness: Yes.
The Court: We do not want what somebody told you about this. What you saw yourself you may testify to, but not what somebody else said to you about what somebody else found.
Mr. Cooper: Q. Subsequent to this time, did Dr. Gans show you a different arrangement or device?
The Witness: Yes.

315 Q. What was that?

A. He designed an aparatus where excelsior was absent, and instead of such there was aranged devices—

Q. The rising space?

A. Rising space, free space.

Q. And subsequent to that, did you see such apparatus tested?

A. Yes. We saw same and tested same.

Q. That is by we, you mean Grove?

A. Grove built some and sold some to Permutit.

Q. And subsequent to that time was it that the Permutit Company in Germany was created?

A. The Permutit in Germany was created in the year 1909.

The Court: Now when was it that this excelsior was removed in this second apparatus that you speak of; what was the year?

A. That was the end of 1907 or the early part of 1908.

The Court: The early part of 1908?

The Witness: Yes.

The Court: At that time he discarded his excelsior?

The Witness: Yes.

The Court: And after he discarded the excelsior you made some apparatus for him?

The Witness: Yes, in 1909.

The Court: Under his plan?

The Witness: Yes.

316 The Court: Approximately like this exhibit — at the body of excelsior, having an open space inst

The Witness: An open space instead.

The Court: Instead of excelsior?

The Witness: Yes.

The Court: Is that the only difference?

The Witness: That was the only difference at that time, yes.

The Court: What?

The Witness: That was the main departure.

The Court: That was the only material difference you mean?

The Witness: The only material difference. And as I say, some other differences of course.

The Court: Well, later of course?

The Witness: Yes.

Mr. Cooper: Q. Well, now, did there come a time when

you became acquainted with this German Permutit Company?

Mr. Wilkinson: That is immaterial.

The Court: Q. When was it, do you know?

The Witness: The German Permutit Company was organized in the middle of 1909.

Mr. Cooper: Q. And from that time on until you came to this country, you were connected with the German Permutit Company?

A. Oh no. I stayed with this company until November 1st, 1910.

317 The Court: Then you left Grove and came with the Permutit?

The Witness: (Continuing) When I left the firm of Grove November first, 1910, I went with the German Permutit Company, and since that time my relation with the German and American Permutit Companies, has been continued. None of the companies I am connected with or was connected with from 1909 has made an apparatus that did not have this rising space.

Cross-Examination by Mr. Wilkinson.

It was in 1907 that I saw in operation an apparatus like that disclosed in this drawing of the Gebrauchsmuster patent 313,671. That apparatus which I saw operated at that time or attempted to be operated, had a layer of excelsior in it. My counsel referred to another Gebrauchsmuster patent, and I saw an apparatus similar to that attempted to be operated; that is number 341,512. That did not have a layer of excelsior in it. That apparatus was similar like the drawing consisting of a perforated screen and some exchange silicates, and cross pipes dividing the water, and with filter cloths; in Figure 3.

Mr. Wilkinson: Q. When was it that you saw an apparatus like the Gebrauchsmuster patent 341,512 attempted to be operated?

Mr. Cooper: That of course is what my brother insisted I should not ask.

318 Mr. Wilkinson: I am testing his recollection as to these matters. It has gone back a good ways.

A. I saw such a thing in the Permutit Company after the organization, after the Permutit Company was organized in 1909.

Q. Where was it that you saw an apparatus attempted to be operated like that shown in that Gebrauchsmuster patent 341,512, what place?

A. I didn't see it in operation. I saw it standing in the store room of the Permutit Filter Company.

Q. You did not see it in operation?

A. No.

Mr. Wilkinson: I move to strike out all the testimony of this witness relating to anything regarding the disclosures of the Gebrauchsmuster patent 341,512.

The Court: I did not understand he testified as to the disclosure.

Mr. Wilkinson: He was asked by his counsel.

Mr. Cooper: Not except under cross examination.

The Court: I did not understand him to ask him that.

Mr. Wilkinson: His counsel asked him whether or not he has seen in operation in Germany apparatus like the Gebrauchsmuster patents which have been offered in evidence, and these are the only two.

319 Mr. Cooper: I did not ask him the question, but the answer only referred to it.

The Court: If there is anything about this particular one 341,512 it will be stricken.

Mr. Wilkinson: That will be ignored then, what was in the testimony of the witnes regarding that.

The Court: Yes.

The Witness: (Continuing) It was in 1909 that Grove built for the Permutit Filter Company apparatus according to the designs of Gans where no excelsior was used. And in that which was built in 1909, to embody Gans' idea, there was a free space above the bed of zeolite so as to permit boiling. This apparatus embodying Professor Gans' ideas, in which the excelsior was omitted, was built and tested after the organization of the Permutit Filter Company.

The Court: Do you know the date?

The Witnes: I am not sure, but it was about the middle of the year as near as I can remember.

The Court: 1909?

The Witness: 1909.

The Court: I understood that you first saw Professor Gans' apparatus similar to the one illustrated in this drawing of the Gebrauchsmuster 313,671 without the excelsior some time in the middle or later part of the year 1907.

The Witness: No, no. In the latter part of 1907 or the beginning of 1908.

320 The Court: Oh yes.

The Witness: He made an experiment, an apparatus similar to that, without the excelsior bed.

The Court: You said the later part of 1907 or early part of 1908, yes, that is right.

The Witness: And then there came along Gebrauchsmuster, and after that the Permutit Filter Company was organized, and then Grove got orders to build apparatus without the excelsior bed.

The Court: And built the min 1908?

The Witness: In 1909, after the organization of the Permutit Filter Company.

The Witness: (Continuing) Between the latter part of 1907 and the latter part of 1908 Gans came often, almost every week. Sometimes only every fourteen days, to our office. I would say about twenty to thirty times. He always came and asked about the details, how to do one thing and how to do another thing.

That of the Gebrauchsmuster 313,671 apparatus when I saw it, I was informed that it was about a year old, and since they discarded it.

It was in the early part of 1908 that it was decided that the device of Gebrauchsmuster 313,671 did not operate properly. I don't remember the date. I don't remember the month and the day, but shortly after I saw it. I saw it December 1907 or January or February 1908. So far as I am concerned, it proved to be a failure in December 1907 or January 1908. I saw the apparatus, I formed my own judgment, that the zeolite could not work, and that was also confirmed later on.

321 Q. Did you reach the conclusion as to just why it was so dirty? Did you know why it was so dirty?

A. I saw it.

Q. Well, you are an engineer, are you?

A. I am.

Q. Did you have any reason why this device in your opinion was not operative?

A. I formed later an opinion about it.

Q. When did you form an opinion?

A. After Gans showed me in his laboratory what his ideas are to operate such apparatus.

Q. How long after was it than January 1908?

A. About two or three or four months later.

Q. Two or three or four months. Then in April 1908, Gans showed you the solution to the problem?

A. About, yes.

Q. And he said then he would have to have the bed free and unconfined?

A. Yes.

Q. And from the middle of April 1908, Gans had in mind the free and unconfined bed?

A. That is the way he made his experiments.

The Witness: (Continuing) I go to Germany about every year, I was in Germany this year; I did not call upon Mr. Gans. He was alive last year. He was in this country last year. I did not see him when I was in Germany.

322 (Depositions of the following named witnesses as printed in a volume which contains defendant's Exhibit 44; Haas, Lipsky, Luthy, Bertsche, Mueller, Green, Regan, Scholl, and Mason, marked Plaintiff's Exhibit J.)

(Three exhibits printed in the volume Defendant's Exhibit 44, and numbered 50, 52 and 37, marked Plaintiff's Exhibits K, L and M.)

Mr. Bakewell: Plaintiff offers in evidence extracts from the testimony of Alfred Mueller, as referred to in the stipulation of October 18, 1929, which is marked Defendant's Exhibit 45.

323 The Court: I understand it is part of the exhibit that Defendant has offered, as Defendant's Exhibit 45. I understand the entire transcript of the testimony is offered and received in evidence.

Mr. Bakewell: That is satisfactory. It is stipulated that if Alfred Mueller were called as a witnes he would testify as follows:

324 "ALFRED MUELLER, Being first duly sworn, deposes and says:

"From 1897 to 1899, I practiced in Germany before the German Patent Office, and since the fall of 1899, I have practiced in this country, specializing in foreign patents and particularly in German patents, I have since then taken out several thousand German patents. I also make a practice of keeping German patents obtained by me in force by paying the annual taxes thereon.

"The patent laws in Germany in the years 1908 to 1912 contain a provision for the lapsing of forfeiture of patents by the failure to pay the annual taxes thereon.

"On every patent an annual tax must be paid and if not so paid within a grace of twelve weeks from the date when the tax is due, the patent lapses.

"I have examined the Patentrolle for the year 1910, 1911 and 1912, which is a publication issued by the German Patent Office each year and contains a list of all patents still in force. This publication is entitled 'Verzeichnis der von dem Kaiserlichen Patentamt', etc.

"The German patent to Leister 211,064 is not mentioned as being in force on March 1, 1911, or on March 1, 1912, and it must therefore have expired in 1910. This patent 211,-064 is dated January 3, 1908. The third annuity was due on January 3, 1910, and allowing for the legal grace of twelve weeks, could have been paid with a fine up to April 16, 1910. At that time the tax necessary to keep this patent alive would have been one hundred marks.

"The Patentrolle for 1909, published in 1910, shows that this Leister patent 211,064 was assigned to and owned by the Riedel Stock Company of Berlin.

"I testified to the above facts in the suit of Permutit Co. v. Wadham *et al*, in the U. S. District Court for the Eastern District of Michigan, Southern Division."

325 Mr. Cooper: There is only one possible other matter, and that is this, if your Honor please. I think it appears in the concession of the defendant's counsel that all the prior patents and publications on which they rely, with the single exception of the Weiss article of 1910, were before the New York Court of Appeals and the Cincinnati Court of Appeals on those trials. I mean on the appeals there. If that is not conceded then what I should like to do would be to mark them for identification, or offer as physical exhibits, solely for the information of the court, the records of those cases so that the court can see what was before those courts.

Mr. Byron: I do not care to make any concession there unless I can see the details and find out, so I suggest he put in a certified copy.

The Court: These things on these various trials refer apparently to everything, but perhaps they do not refer to everything before the court. I don't know.

Mr. Cooper: I think not.

The Court: You may offer them if you wish for that purpose. You probably can cover that in a stipulation afterwards.

Mr. Cooper: Might it be left this way that either side might refer to those records in this litigation for the sole purpose of showing either this court or the Court of Appeals what was before that court.

The Court: Those courts.

Mr. Cooper: Yes.

326 The Court: Is that satisfactory?

Mr. Byron: Oh yes, indeed.

Mr. Cooper: Then we do not have to impound them. That is all.

Whereupon the defendant offered the following evidence in sur-rebuttal:

(Certified copy of the Gans file wrapper and contents of the Gans patent in suit, marked Defendant's Exhibit 65).

Mr. Byron: Defendant wishes to put on a few witnesses to show that a bed that is locked is not inoperative, it is perfectly operative, and there are a lot of them in operation to-day in commerce used for performing the usual functions.

Mr. Cooper: Well, I think that was a part of their case, if your Honor please.

Mr. Byron: No, that is the very thing we talked about before.

The Court: I suppose you want to show some of the developments of the plaintiff's rebuttal. That is proper.

Mr. Cooper: If the court please, Dr. Moses went into this quite extensively and I cross examined him on it.

Mr. Byron: I want to refer to specific installations which they say were inoperative, and now we are going to show the operativeness by actual use.

327 DOUGLAS V. MOSES, Recalled as a witness by the defendant in sur-rebuttal, testified further as follows:

Direct Examination by Mr. Byron.

Friday, November 1, 1929.
9:30 o'clock a. m.

The drawing marked for identification as Defendant's Exhibit 66, was made at my direction from a sketch made on

a blueprint showing the exterior of a softener installed at the Desplaines river sewage treatment plant, located at Maywood Illinois. The sketch illustrates the machine as I found it when it was dismantled for inspection. It is a down-flow softener. Upward Regeneration. Upward rinse. I first saw this water softener in its installed position and operating at Maywood, Illinois in November, 1928. I last saw it in the same condition during the early part of last week. It is noted from this blueprint that there is a distance of three-quarters of an inch between the indicated screen and the top of the zeolite bed. I personally measured the distance between the indicated screen and the top of the zeolite bed, during last week.

Ordinarily a zeolite bed shrinks as the result of being used. I found a distance ranging from one-half to one inch between the indicated screen and the top of the zeolite bed. Of course, in making the measurement down on the body of the zeolite bed, it is not very easy to be as accurate as a quarter of an inch.

328 I have tested the effluent water of that particular water softener for hardness. I did that during my visit last November. The water issuing from the softener was soft to the B and B soap test. I am told the hardness of water being softened by that machine is twenty grains. I do not know of my own knowledge. This softener has been in regular service when I have seen it.

Cross-Examination by Mr. Cooper.

The make of this softener I must refer to hearsay is an International Filter Company softener. I was not able to find any nameplate.

Mr. Byron: We are admiting, your Honor, that the International Filter Company is a licensee of plaintiff.

Mr. Cooper: And then I suppose, since the matter of the make of this is hearsay, you might as well concede the point that it is an International Filter product.

Mr. Byron: Yes, we think it is. I was going to establish that point if I could.

Mr. Cooper: Well, I will relieve you of that. I think that's all I have to ask, your Honor.

329 RUSSEL S. SMITH, a witness called by defendant in sur-rebuttal, being first duly sworn, testified as follows:

Direct Examination by Mr. Byron.

My name is Russel S. Smith; age, 31. Residence; Maywodd Illinois. I am sanitary engineer for the Sanitary District of Chicago.

The copy of defendant's exhibit 66 for identification which you hand me seems to show the piping on the large water softener at the Desplaines river treatment works. It was made by International Filter Company. I was present with Dr. Moses last week when he measured the distance between the indicated screen and the top of the mineral bed; I checked him on those measurements. I found that the mineral bed was from approximately three-quarters of an inch to approximately an inch below the screen. My own independent measurement.

Cross-Examination by Mr. Cooper.

I had not made such measurements previously. The filter was bought sometime in the spring of 1928. I can not tell you what had been the last flow through the device before it was opened and measured. The recording meter was out of order clogged. I have no measurements since January, 1929.

330 *Redirect Examination by Mr. Byron.*

The top of this casing was not removed any time before last week, to my knowledge. I don't think the International people have ever been asked to repair the meter. This water softener has been in regular use for softening water over the period in which it has been installed.

Q. Do you know how frequently the water softener is regenerated?

A. It varies greatly, according to the rate of use I have been told by the chemist who is in charge.

Mr. Cooper: I object, then, if your Honor please.

The Court: Yes. Sustained.

Mr. Byron: Q. Do you know how often it is regenerated ordinarily?

A. Varying from—

Mr. Cooper: You will have to establish the matter of his personal knowledge.

The Court: You can question him on that.

Mr. Cooper: Do you know how often?

A. Only by report to me from the chemist, who operates it.

331 *Recross Examination by Mr. Cooper.*

I have never operated the regeneration of the softener. That has been done by the chemist. Three months last fall I was at the north side plant and not at Maywood, but I was not told that the head had been removed and to the best of my belief it had not been removed.

332 E. H. MORGAN, a witness called on behalf of the defendant, testified in sur-rebuttal as follows:

Direct Examination by Mr. Byron.

My name is E. H. Morgan; age thirty-two; residence, Oak Park. I am Sanitary chemist at Sanitary District of Chicago the Desplaines River Sewage Treatment Plant.

Defendant's Exhibit 66 for identification which you hand me appears to be a water-softening device with regenerating equipment. It is a diagrammatic sketch of the water softener, the International water softener which is installed at the Maywood plant to which I referred. I have charge of this particular water softener. It is a down-flow softening machine; up regeneration. We rinse in both directions. The hardness of the raw water which we use at Maywood and which is softened by the apparatus in question is about 22 grains. This raw water is softened by passing through this particular softener.

Our test for soft water is the soap test; it consists of taking a sample of the water after it has passed through the softener and applying three drops, as we apply it, in
333 15 cc. If after shaking a foam remains for a period of about a minute, we conclude that the water is soft.

This softener is in a position to be in continuous use but our demands upon it are not necessarily continuous. The period for regererating this softener varies with the usage

of the water. It has run as long as five weeks between regenerations. The shortest period between two regenerations is three days later.

The capacity of that softener in so far as softening water is concerned is 15,000 gallons. Our records are meager but what we have would indicate that between regenerations 16,000 gallons plus or minus a few gallons flows through the softener. To my knowledge that particular softener has been in use at the Maywood plant since July 24, 1928. The top of that softener was removed this week. It was never removed before to my knowledge. I have had continuous charge of that softener over the period from the middle of last week up to the present time.

Cross-Examination by Mr. Cooper.

This soap test was three drops in fifteen cubic centimeters. The soap used is a solution that was provided by the company that furnished another softener, a smaller softener that we previously had. I cannot recall now if it was what has been designated the B and B solution. The lebal is on the bottle and I could show the bottle, but I don't recall just now. I do not know the relative strength of that solution with respect to a B & B solution.

334 *Redirect Examination by Mr. Byron.*

I stated that another company that has a softener in that same plant furnished the particular soap; it is The Permutit Company.

335 LUCIUS A. FRITZ, recalled in sur-rebuttal as a witness on behalf of defendant, testified as follows:

Direct Examination by Mr. Byron.

I know of an installation of a water softener of the zeolite type in which the upper screen is down tight on top of the bed of zeolites. Well, there are quite a number of installations. We have used the bed without a free board at the top, usually in practice. If we encounter a condition where there is very limited floor space and limited headroom

and it is desired to secure a definite quantity of water, we will insert at the top of the tank the so-called sand tight strainers and fill the tank with zeolite to realize an increased capacity per regeneration. We are doing this quite frequently, depending upon the conditions in the field, and I imagine that we have at least a hundred such installations in service in this country. One in particular that I am familiar with is the installation that was placed in the estate of the late Ambassador Herrick to France, located at Cleveland, where the space was limited, the openings in the building were quite limited and a certain quantity of water was desired. In this particular installation we used the sand tight strainers and filled the tanks completely full with zeolite and the equipment has been in service for a year and a half
336 and we have not had one single complaint from operation. When I say "we" I refer to the manufacturer, the Elgin Softener Corporation.

Cross-Examination by Mr. Cooper.

I do not have a sketch or drawing which will show what these sand strainers are, but they are simply the old sand strainers. We have used them in filtration practice for that, where we have to limit the zeolite bed. We build them seven or eight inches long, a cylinder with slots of such size that the slot is less than a granule of zeolite so as to prevent the zeolite from passing out from the tank. They have been quite frequently used in past work in filtration. Those are vertical.

Redirect Examination by Mr. Byron.

The zeolite is around these vertical strainers and up to the top of the tank. The horizontal portion of the machine from which the vertical strainers depend or extend upwardly actually engage the zeolite bed.

Recrass Examination by Mr. Cooper.

As a rule we have a manhole at the top of the tank, or manhole plate to get the zeolites in.

337 *Redirect Examination by Mr. Byron.*

You have a manhole plate at the top of the tank and there is an opening on the top here of the tank and you simply put in the zeolite until it is filled up and then you put your manhole plate back into position. That's as much zeolite as you can get into the tank.

Recross Examination by Mr. Cooper.

Q. Do you put the zeolite in dry or wet?

A. The zeolites are usually placed in a tank in a dry condition.

Q. And then when they are wet do they tend to grow less in volume or grow larger in volume?

A. Well, it is slight.

Q. Well, which way?

A. Yes, it is slight.

Q. I say, do they tend to grow less in volume or greater in volume?

A. No, the dry zeolite when you place water on it, the shrinkage that you speak of is not so large. We put as much zeolite as we can possibly put into the tank, fill it up as full as it will take the zeolite, and that's about all you can get into the tank.

338 Q. And then when it is wet, the zeolite bed has shrunk some?

A. Very slight.

Q. But it has shrunk some, was my question.

A. It has shrunk some.

Q. So that there is some space at the top, then?

A. Well, we put as much zeolite— —

Q. No, no. Listen to my question.

Mr. Cooper: Will you read the question?

(The question was read.)

A. If there is space—

Q. No, no. I say, so that there is some space at the top?

A. There is an insignificant space at the top of the head of the tank.

Redirect Examination by Mr. Byron.

Q. What do you mean by insignificant space at the top?
A. Well, I imagine if you say an inch or an inch and a half at the outside.
Q. In what diameter of tank would that be?
A. Well, this particular installation I mentioned was 36 inches in diameter and the head was such that, I imagine there was about an inch, a little over an inch space at the top head.

339 (Document heretofore marked DEFENDANT'E EXHIBIT 66 for identification received in evidence)

340 CHARLES P. EISENHAUER, being first duly sworn, testified in sur-rebuttal on behalf of defendant as follows:

Direct Examination by Mr. Byron.

My name is Charles P. Eisenhauer; age 38; residence Dayton, Ohio. My occupation is General research work and engineer, the Duro Company. The Duro Company is a licensee of the plaintiff here, to my knowledge. I have been in the water softening business six years.

This cylinder here (indicating) is a water softener; It is one of The Duro Company G models, synthetic type softener. I personally designed that machine. I think the depth of the bed of zeolite in this tank is around twenty inches or so. There is a screen in the top of this cylinder. There is a space between that screen and the top of the zeolite bed. It is about one half or two inches or so. We don't pay a lot of attention to it. Well, it is designed to have free space. I would have to qualify that somewhat in order to show the reasons why.

(Witness removes the cover as directed) It has been shifted to one side there, but the indications are that the mineral was to that height or that level (indicating). That's approximately two inches. (Witness flattens it off as directed). About two inches.

341 This is an up-flow softening machine. There is a screen attached to the cover plate of this softener.

The water is flown into the softener at the bottom, up through the mineral and out the screen at the top and then

when regeneration is desired to the mineral, it is regenerated by passing brine in at the top and passing it out at the bottom and putting it back into operation. We have no complaints whatever about channeling.

It is the best construction that we could obtain for that purpose. This is the normal amount of zeolite that is placed in all machines of this type of the Duro construction. We have been selling the screen type for about four years. We started in July, 1925. I expect we have got at least 30,000 screen dyes out. We sell them in Canada, United States, England and various places. We limit our manufacture of water softeners to the up-flow type.

Q. Please state whether or not in your opinion the up-flow type is superior to the down-flow type, or vice versa.

A. I do.

Mr. Cooper: That is hardly within the re-opening.

The Court: I do not think so, either.

Mr. Byron: Q. What is the answer?

A. I do.

Q. Do what?

A. Think the up-flow is superior.

342 Mr. Cooper: I did not know the re-opening would include that.

The Court: I said I did not either.

Mr. Byron: Q. And you give that answer as the result of your experience, do you?

A. Yes, sir.

Mr. Byron: That is all.

Cross-Examination by Mr. Cooper.

I do not know that my company has only a license to make the up-flow type.

Mr. Cooper: That license, I may say to your Honor, is a matter of record in this case because there were some proceedings—

The Witness: (Continuing) I do know we only asked for that. We would not make any other type. I don't know what the final decision was.

Now, it is a fact, if this zeolite bed were wet it would shrink, rather than expand. In this particular one which has been looked at here, according to my experience the bed would shrink between five and ten per cent, depending upon the size of the grain if it were wetted. It is the fact that once

one of these devices has been put into service, as long as it is in continuous service, including regenerating periods, the zeolite bed is always wet, that is, it never gets a chance to dry out.

343 *Redirect Examination by Mr. Byron.*

The Duro Company in shipping those softeners of the type before me float the zeolite into the tank with water.

(Model G, machine built by Duro Company, received in evidence as Defendant's Exhibit 67.)

Recross Examination by Mr. Cooper.

The zeolite bed in the device that has just been offered in evidence is not dry now. I should say it was around 45 per cent wet. We don't agree on the particular term for the 100 per cent. Normally we speak of moisture content of the mineral. You are speaking of how wet the surface is. I spoke of a 45 per cent moisture content of the mineral. I would not know offhand if it was that per cent because all we do is simply let the water run out and leave all the water that remains in there. It feels wet to me.

The Court: When you ship this softener and you put the zeolites in damp, how full do you fill the softener?

A. We flow the water up through the tank, allow the mineral to come in from the top. We have a trap and the mineral floats down in from the chute, the water shooting up from the bottom, and after the man gets what he thinks
344 is full he shuts off the valve, drains the water down to the mineral to see how far it is below the top and he measures it roughly with a wooden gauge marked at a half an inch along its length.

The Court: How much is that space?

A. On one side two and one-fourth, about two inches. It is immaterial, really, what that space is.

The Court: I am not asking you that.

The foregoing narrative statement of the testimony taken in the above entitled cause is hereby approved.

DYRENFORTH, LEE, CHRITTON & WILES
Counsel for Plaintiff.

WILKINSON HUXLEY BYRON & KNIGHT
Counsel for Defendant.

(Endorsed) Filed May 8, 1930 Charles M. Bates, Clerk.

345 And on to-wit: the 8th day of May, A. D. 1930, there was entered in said Court the following Order, to-wit:

346 * * (Caption.) * *

Thursday, May 8th, A. D. 1930

Present: Hon. Walter C. Lindley, District Judge.

ORDER.

By agreement of counsel for the respective parties in the above entitled cause,

It Is Ordered by the Court that the narrative statement of the testimony taken herein, prepared by counsel for plaintiff, and approved by counsel for both parties herein, be and the same is hereby approved.

Dated May 8, 1930.

WALTER C. LINDLEY
United States District Judge.

Approved:

DYRENFORTH LEE CHRITTON & WILES
Counsel for Plaintiff.

Approved:

WILKINSON HUXLEY BYRON & KNIGHT
Counsel for Defendant.

351 And on to-wit: the 29th day of May, A. D. 1930, there was filed in the Clerk's office of said court the following Exhibits to-wit:

352

PLFFS. EX. 1.

* * (Caption.) * *

STIPULATION

Filed May 29 1930 at ..... o'clock .....M. Charles M. Bates Clerk

It is stipulated by and between counsel for the respective parties as follows:

1. That plaintiff is incorporated as alleged in the bill of complaint, and was so incorporated more than six years prior to the filing of said bill; that plaintiff is now and has been, since November 10, 1916, the owner of the Gans patent in suit, No. 1,195,923, and of any and all claims for profits and damages for infringement of said patent.

2. That printed Patent Office copies of United States and foreign patents or photostats thereof, and any printed publications or photostats thereof, may be received in evidence with the same force and effect as originals or duly certified copies, and that the effective dates thereof shall be prima facie deemed as follows; of United States patents, the filing dates; of British patents, the date of sealing; of Ger-
353 man patents, the "ausgegeben" dates; of of Austrian patents, the date stated thereon as the publication date; and that other formal dates appearing on said printed or photostatic copies of said letters patent, including the filing date, and that the publication dates appearing on such printed publications or photostats thereof, shall be taken as prima facie correct; all subject to correction of error, if error shall appear.

3. That a copy of the testimony given by Sheridan S. Norton, Samuel B. Appelbaum, and Arthur E. Howlett, with the objections raised in connection therewith, in the suit of the Permutit Co. v. Wadham, et al and the Borromite Company of America, as such testimony and objections appear at pages 64-95, Vol. 1, of the Transcript of Record on Appeal to the U. S. Circuit Court of Appeals for the Sixth Circuit, No. 4105, may be received in evidence herein with the same force and effect as if each of said witnesses appeared and so testified herein, with the understanding however that the defendant herein makes as its own, the objections raised

in connection with said testimony; and that the exhibits, or copies thereof, referred to by such witnesses, and offered in evidence in that suit, may also be offered and used in evidence here, without further proof.

4. That defendant, since the issuance of the Gans patent in suit, and within six years prior to the filing of the bill of complaint herein, manufactured and sold water softening apparatus identical with those disclosed and shown in each of Plaintiff's Exhibits 10, 11, 12, 13, 14, 15, 16, 30 and 31, filed on the motion for a preliminary injunction herein; and, during the same period, made water softening apparatus, the same in principle as that purchased by plaintiff from
354 the defendant on or about June 16, 1928, except the apparatus purchased by plaintiff was modified as requested in plaintiff's letter of June 8, 1928 to defendant, and as shown in defendant's drawings ZW-608, dated 6-22-28, and ZW 338-A, dated 3-1-27 which device was made especially for plaintiff and embodied the requested changes which consisted only of a manhole as indicated at "M" on said drawing ZW-608 and a welded-on flange with a 4 inch pipe opening provided with a threaded plug all as indicated at "N" on said same drawing.

5. That the catalogues filed on the motion for preliminary injunction as Plaintiff's Exhibits 10, 11, 12, 13, 30 and 31, were duly issued by defendant within six years prior to filing the bill of complaint herein, and that photostatic copies thereof may be received herein with the same force and effect as the originals.

6. That for the purpose of expediting the trial of this case as to the Gans patent in suit, plaintiff may dismiss the bill of complaint herein, without prejudice, as to the patent to Borrowman, No. 1,348,977, and the patent to Spencer, No. 1,455,363; and plaintiff stipulates that it will so move the Court, at or prior to the trial of this suit.

DRURY W COOPER
Counsel for Plaintiff.

Dated March 30, 1929.

WILKINSON HUXLEY BYRON & KNIGHT
Counsel for Defendant.

355 (Endorsed) * * (Caption) * * Stipulation Filed May 29 1930 at ..... o'clock M. Charles M. Bates Clerk.

356 PLTFF'S EX. 2.

Filed May 20 1930 at ..... o'clock ..... M. Charles M. Bates Clerk.

A. I. A. Standard File 29 d 32
Graver
Zeolite Water Softener

Water Without Hardness

Bulletin 509 February 1, 1923

Graver
Water
Softening & Purification
Headquarters
Graver Corporation
(Wm. Graver Tank Works - Founded 1857)

Steel Tanks and General Steel Plate Construction
Water Softening and Purifying Equipment

East Chicago, Indiana

357 ZEOLITE

Zeolite is the geological name of a mineral that is a hydrated silicate of aluminum, combined with an alkali or an alkaline metal, or both. Zeolites are widely found in nature and their action has been known for a long time to investigators in Geology, Mineralogy and Chemistry. It is the property which this mineral possesses for exchanging its base for another base that has led to its employment in the field of water softening. As is well known, calcium (lime) and magnesium salts make water hard, and it is the replacement of the calcium and magnesium from these salts by the sodium base of the zeolite that makes water soft.

358 Bulletin 509 Page 3

Graver Corporation East Chicago, Indiana
Graver Zeolite Softener—Water Without Hardness

The Chemistry of Zeolite Water Softening

Expressed in its mineralogical form, an empirical formula for a perfect zeolite would appear as follows:

$$Na_2O.Al_2O_3.SiO_2+6H_2O$$

in which the sodium oxide (Na_2O) is the active chemical reagent, the aluminum silicate ($Al_2O_3.2SiO_2$) the non-destructible body or medium in which the reactions proceed and the water (H_2O) the means for bringing the chemicals together in solution, allowing the reactions and exchange.

The chemical changes that occur in water softening are equated below. For convenience the lengthy formula for the zeolite given above is designated as Na_2Z.

$\left\{\begin{matrix}Ca(HCO_3)_2\\ \text{Calcium Bi-carbonate}\end{matrix}\right.$ $\left\{\begin{matrix}CaSO_4\\ \text{Calcium Sulphate}\end{matrix}\right.$ $\left\{\begin{matrix}CaCl_2\\ \text{Calcium Chloride}\end{matrix}\right.$	$+Na_2Z=CaZ+$		$\left\{\begin{matrix}2\,NaHCO_3\\ \text{Sodium Bi-carbonate}\end{matrix}\right.$ $\left\{\begin{matrix}Na_2SO_4\\ \text{Sodium Sulphate}\end{matrix}\right.$ $\left\{\begin{matrix}2NaCl\\ \text{Sodium Chloride}\end{matrix}\right.$
Soluble Hardening Ingredients in Natural Waters	Insoluble Sodium Zeolite	Insoluble Calcium Zeolite	Soluble Sodium Salts Remaining in Water

Magnesium salts react in the same manner.

It will be noted that the softening is effected by a mere exchange of bases. The softened water contains sodium salts in amounts and combinations equivalent to the original hardening salts in the water, no sludge or precipitates forming in the process.

When the exchange of sodium for the calcium and magnesium has reached its economic limit another equally remarkable property of the zeolite is utilized for rejuvenating or restoring it to its original condition. This is done by permitting it to come in contact with a strong solution of sodium chloride (common salt) when the exchange is reversed, as shown below:

CaZ	+	$2NaCl$	=	Na_2Z	+	$CaCl_2$
Insoluble Calcium Zeolite		Salt Solution		Insoluble Original Sodium Zeolite		Soluble Waste Calcium Chloride

It is what is known as "Mass Action" that causes the chemical reaction to reverse itself. The sodium of the salt substitutes itself for the absorbed calcium and magnesium and the resulting soluble calcium and magnesium chlorides are washed away with clean water. The brine solution is made strong enough to accomplish this quickly and effectively. There is no loss in exchange properties in this process, which can be done repeatedly.

359 Page 4 Bulletin 509

Graver Corporation East Chicago, Indiana
Graver Zeolite Softener—Water Without Hardness

Commercial Zeolites.

The Zeolites used in practical water softening are spoken of as natural and artificial. Contrary to the general impression, no zeolite as found in nature is commercially feasible. The so called natural zeolites on the market are substances with exchange properties artificially intensified, while the artificial zeolites are synthetically prepared.

Graver Zeolite.

Graver Zeolite is a new discovery in zeolite softening substances, prepared by an original, distinct method. It is a manufactured sodium aluminum silicate in the form of white, small, porous granules, which are insoluble in water.

1. It possesses a large quantity of active alkali base (Na_2O) which can be utilized so as to produce large amounts of soft water per unit weight.
2. The granules are tough so that water erosion and loss in treating capacity is negligible.
3. The granules are of such size and uniformity as to expose as great a surface as possible to the action of the water, and are sufficiently porous for the water to permeate into the interior and thereby increase their ability to soften water.
4. The rate of softening is rapid, the usual rate of flow, depending on the hardness of the raw water, varying from 1 to 4 gallons per square foot of area per minute.
5. While the action of the material is based upon a uniform flow per hour for a period of from ten to twelve hours the exchange activity is so rapid that the entire capacity can

be utilized in one-half to one-fifth of this period depending on the hardness of raw water. This action is most advantageous in meeting temporary peak load demands.

6. The time required for regeneration is about twenty minutes and the cost for salt, which is all that is required, is extremely low. Under normal operating conditions a zeolite operating on day shift is regenerated at night, and can be made ready for the next day's run in less than one hour. Some operators prefer to regenerate during the noon hour. Where twenty-four-hour service is required, two units are used, or in special circumstances one unit with tank storage of sufficient amount to carry the load during the time the softener is being restored.

7. Quick regeneration is of immense advantage. Where the water fluctuates in hardness or the individual daily runs vary considerably, it permits of stopping the softener, regenerating, putting into operation with but slight impairment to he routine of work.

8. The mechahical apparatus utilizing this zeolite is compact, occupies little floor space, is easily assembled and is constructed in our own steel plate and machine shops.

9. Although Graver Zeolite is a new discovery it has been very thoroughly tested by actual runs under extreme conditions over a long period of time. These tests have completely demonstrated the advantages given above.

Water Without Hardness.

Water passing through a bed of Graver Zeolite has every trace of lime and magnesia removed as determined by any accepted soap test, regardless of extreme changes in character or in the amount of hardness. The softened water is perfectly soft, non-scale forming and absolutely neutral in the presence of a test indicator as phenolpthalein. It will lather instantly, remain clear and will not destroy soap.

362 Bulletin 509 Page 7

Graver Corporation East Chicago, Indiana
Graver Zeolite Softener—Water Without Hardness

Graver Zeolite Softeners are made for Industry and Home in a wide range of sizes suitable for any capacity. As the size depends on the hardness of the raw water it is necessary that a chemical analysis be made of the water to be softened. We are always glad to make chemical analyses free of cost on any sample submitted. For this purpose about one gallon is required. This should be shipped in a clean glass bottle, carefully boxed and marked with your name, address and source of supply. It is also essential to know the quantity of water to be softened per day and per hour, also the number of hours the softener will be operated each day.

For these industries the Graver Zeolite Softener is indispensable:

Laundries	Textile Establishments
Bleacheries	Silk Mills
Dye Houses	Woolen Mills
Paper Mills	Cotton Mills

Its field of usefulness is also large in:

Tanneries	Chemical Plants
Sugar Refineries	Gas and Oil Engines
Ice Plants	Institutional Buildings
Bottling Works	Hotels and Apartments

We have figures showing definite and wholesome savings in each case which we would like to submit to you. We can also refer you to the users of Graver Zeolite Softeners whose experience with them will be convincing as to their value.

363 Page 8 Bulletin 509

Graver Corporation East Chicago, Indiana
Graver Zeolite Softener—Water Without Hardness

Graver Quality is a symbol. It is a growth of 65 years. It is a mark of value and merit recognized wherever steel tank or plate construction in many forms is met. And this Graver Quality is attached to the whole field of Water Treatment Equipment described in this bulletin and the others listed below.

We believe, we are today the largest and only company manufacturing in its own works and offering a line of Water Purifying, Water Softening and Water Heating Apparatus and accessories for every want—industrial, domestic or community. For this reason we can offer without bias and execute with satisfaction, a method of treatment or combination of methods best suited to a set of conditions with respect to investment, maintenance and desired results.

Our experience in water treatment is extensive. Our organization includes water-works engineers, each a specialist in his own field, who are ready to confer with you in your problems and whose recommendations are based on a thorough on-the-ground investigation. Our laboratory is under the guidance of an experienced water analyst and a chemical report accompanies every proposition submitted. This laboratory, with its facilities, is at your service at any time and all analyses are made free of cost.

Any of the Bulletins named will be sent free upon request.

Water Filters

The Water Supply for Swimming Pools....Bulletin 500
Horizontal Pressure Type Filter..... " 501
Vertical Pressure Type Filter..... " 502

Chemical Softeners

Hot Process Water Softener.....Bulletin 504
Intermittent Water Softener..... " 505
Large Continuous Water Softener (Railroad Type "K") ..... " 506
Small Continuous Water Softener..... " 507
Continuous Water Softener for Raw Water Ice Plants ..... " 508

Zeolite Softeners

Zeolite Softener for Home or Industry....Bulletin 509

The Graver Guarantee, united with Graver Quality, is one you can depend on.

364 PLTFF'S EX. 3.

Filed May 29 1930 at ..... o'clock ..... M. Charles M. Bates Clerk.

A. I. A. File No. 29 d 32
Graver
Zeolite Water Softener
Water Without Hardness
Bulletin 509 June 1, 1925
Graver
Water
Softening & Purification
Equipment
Graver Corporation
Founded 1857
East Chicago, Indiana
Steel Tanks and General Steel Plate Construction
Water Softening and Purifying Equipment
East Chicago, Indiana

365 Graver Builds

Water Softeners
Hot Process
Cold Process
Zeolite
Household
Filters
Pressure
Purifying System
for Swimming Pools
Tanks
Welded
Riveted
RIOW—(Riveted, Inside and Outside Welded)
Structural Supports
Tower Tanks
Standpipes
Any Size Tanks
Erected Anywhere
Refinery Equipment
Jenkins Cracking Process
Stacks-Breechings
General Steel
Plate Construction

366 Water Softening and Filtering

Hard Water

Hardness in water is that characteristic which is imparted to water by the presence of soluble salts of Calcium, Magnesium, Iron and Aluminum. Clear water is not necessarily water free from hardening salts. It may be crystal clear, yet in not unusual cases be exceedingly hard.

Water, as it falls to earth in the form of rain or snow, may be considered, for all practical purposes, to contain no matter in solution with the exception of air and Carbon Dioxide Gas which it absorbs in its descent through the atmosphere. In its subsequent passage over and through the ground, it dissolves many minerals. These may be divided into two classes, those dissolved by the water itself, and those dissolved through the action of the absorbed Carbon Dioxide Gas which combined chemically with the water forms Carbonic Acid.

Nearly all water supply, whether river, lake or well, contains some hardness varying in quantity, upon source of supply, geographical location as well as strata through which the water passes.

Water Softening

The softening of water for practical purposes is accomplished by either one of two methods: by precipitation, most generally called the "lime-soda" process or by exchange, most commonly known as "zeolite" method.

Precipitation Method: The salts of lime and magnesia which are in solution in water can be removed by chemically precipitating them as insoluble compounds that can be separated from the water. This precipitation can be obtained with some of the calcium and magnesia salts by adding common lime (Calcium Hydrate) to water, some by adding soda ash (Sodium Carbonate) and all by adding both lime and soda ash. When these ingredients are added they chemically react with hardening salts, forming insoluble compounds which separate from the water as small white flakes. The amount of lime and soda must be added accurately to the water in proportion to the amount of hardening ingredients which are to be removed. The lime which is used as a precipitating agent is also removed from the solution by the

reaction, becoming insoluble in the process. In the use of soda ash, either or both sodium chloride (common salt) or sodium sulphate, remains in solution as a byproduct of reaction. Neither of these ingredients is of a hardening nature. In some instances caustic soda or tri-sodium phosphate are used in place of lime and soda ash. When the precipitation type of water softener is used, large settling tanks are required as all of the water and chemicals must react for at least four hours to complete the reaction, unless the water is hot. A filter is further required to remove the last trace of the precipitated salts before the water is ready for use. While the precipitation type of softener is divided into two classes, the continuous or the intermittent, the chemical reaction in either equipment is alike.

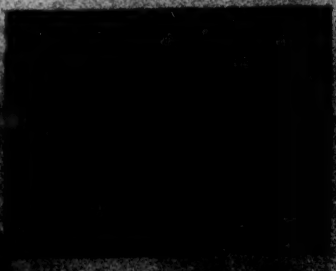
Zeolite Method: The zeolite method is also known as the exchange method. Zeolite is the geological name of insoluble hydrated silicate of aluminum, combined with an alkali or an alkaline metal, or both. Zeolites are widely distributed in nature and their action has been known for a long time to investigators in geology, mineralogy and chemistry. It is the property which this mineral possesses for exchanging its base for another base that has led to its employment in the field of water softening. As water containing hardening salts is passed through this zeolite material it absorbs the lime and magnesia from the water and replaces them with the soda it contains. No sludge or precipitates are formed in the process. The softened water contains sodium salts in amounts and combination equivalent to the original hardening salts in the water. The replacement of the calcium and magnesia from these salts from the sodium base of the zeolite cannot go on indefinitely. When the exchange of sodium for the calcium and magnesium has reached its limit another equally remarkable property of the zeolite is utilized for rejuvenating or restoring it to its original condition by permitting it to come in contact with a solution of sodium chloride (common salt) when the first exchange is reversed. The sodium of the salt substitutes itself for the absorbed calcium and magnesium and the resulting soluble calcium and magnesium chlorides are washed away with clean water. The salt solution is made strong enough to accomplish this quickly and effectively. There is no loss of the exchange properties in this process which can be done repeatedly. The zeolites used in practical water softening are spoken of as natural and artificial.

Water Filtering

Filtration of water as generally defined means the removal of suspended matter visible to the unaided or naked eye. In the process of filtration the finest particles of organic matter which exist in a state of suspension and practically all bacteria and some color are removed. Filtration, as commonly practiced, consists of passing water downward through layers of finely divided filtering media such as sand or quartz. The water passing downwardly through this sand or quartz percolates through the small voids or interstices between the sand particles which retain the finely divided suspended matter while permitting the clear, filtered water to pass on. When the filtering material becomes laden with suspended matter it is cleaned by reversing the flow of the incoming raw water from a downward to an upward direction. This causes all of the retained suspended matter to be washed from the upper surface of the filtering material to waste. Filtering and subsequent removal of the accumulated suspended matter from the top of a filtering bed can only be accomplished where water passes in a downwardly direction through the filter bed when filtering, and in an upward direction when washing.

A FEW TYPICAL INSTALLATIONS

A Laundry Installation



For Softening the Boiler Feed Water of a Distilled Water Ice Plant

A Laundry Installation

For Softening the Boiler Feed Water of a Distilled Water Ice Plant

HOUSEHOLD TYPE ZEOLITE SOFTENERS

Model D

This model is made in three sizes, 18", 20" and 22" in diameter by 3'6" high. Salt for regeneration is introduced through the cast iron salt pot which is part of the pipe nest. This model will answer requirements for any domestic installation. The three sizes give an exceptionally wide range of capacities.

Model C

This model is identical with the industrial type described in this bulletin. The size and connections are the same as Model D. As the salt tank holds sufficient salt for several months, it is most convenient and easy to operate and is used for those installations where these factors are paramount.

Model S

This model is made in one size only, 15" in diameter by 3' 6½" high. Salt for regeneration is introduced through the cast iron funnel on the top of the container. This softener is designed for use only where small amounts of softened water are required, such as barber shops, beauty parlors, automobile filling stations, offices, etc.

371 Zeolite Water Softener

Graver Quality is a symbol. It is a growth of 67 years. It is a mark of value and merit recognized wherever steel tank or plate construction in many forms is met. And this Graver Quality is attached to the whole field of Water Treatment Equipment described in this bulletin and the others listed below.

We believe we are today the largest and only company manufacturing in its own works and offering a line of Water Purifying, Water Softening and Water Heating Apparatus and accessories for every want—industrial, domestic or community. For this reason we can offer without bias and execute with satisfaction, a method of treatment or combination of methods best suited to a set of conditions with respect to investment, maintenance and desired results.

Our experience in water treatment is extensive. Our organization includes waterworks engineers, each a specialist in his own field, who are ready to confer with you in your problems and whose recommendations are based on a thorough, on-the-ground investigation. Our laboratory is under the guidance of an experienced water analyst and a chemical report accompanies every proposition submitted. This laboratory, with its facilities, is at your service at any time and all analyses are made free of cost.

Any of the Bulletins named will be sent free upon request.

Water Filters
Vertical and Horizontal Pressure Type....Bulletin 501
Chemical Softeners
Hot Process Water Softener.....Bulletin 504
Cold Process Water Softener for Railroads.Bulletin 506
Continuous Cold Process Water Softener..Bulletin 507
Zeolite Softeners
Zeolite Softener for Home or Industrial Purposes .....Bulletin 509
Swimming Pools
The Water Supply for Swimming Pools....Bulletin 500

The Graver Guarantee, united with
Graver Quality, is one you can depend on.

A. I. A. File No. 29 d 32

372 PLTFF'S EX. 4.

Filed May 29 1930 at ..... o'clock ..... M. Charles M. Bates Clerk.

Graver
Zeolite Water Softener
Water Without Hardness

Bulletin No. 509 Oct. 15, 1927

Graver
Water
Softening & Purification
Equipment

Graver Corporation
Founded 1857
Steel Tanks and General Steel Plate Construction
Water Softening and Purifying Equipment
East Chicago, Indiana
A. I. D. File No. 29 d 3

373 Hard Water

Hardness in water is that characteristic which is imparted to water by the presence of soluble salts of Calcium, Magnesium, Iron and Aluminum. Clear water is not necessarily water free from hardening salts. It may be crystal clear, yet in not unusual cases be exceedingly hard.

Water, as it falls to earth in the form of rain or snow, may be considered, for all practical purposes, to contain no matter in solution with the exception of air and Carbon Dioxide Gas which it absorbs in its descent through the atmosphere. In its subsequent passage over and through the ground, it dissolves many minerals. These may be divided into two classes, those dissolved by the water itself, and those dissolved through the action of the absorbed Carbon Dioxide Gas which combined chemically with the water forms Carbonic Acid.

Nearly all water supply, whether river, lake or well, contains some hardness varying in quantity, upon source of supply, geographical location as well as strata through which the water passes.

387 Graver Zeolite Water Softener

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Our experience in water treatment is extensive. Our organization includes waterworks engineers, each a specialist in his own field, who are ready to confer with you in your problems and whose recommendations are based on a thorough, on-the-ground investigation. Our laboratory is under the guidance of an experienced water analyst and a chemical report accompanies every proposition submitted. This laboratory, with its facilities, is at your service at any time and all analyses are made free of cost.

Any of the Bulletins named will be sent free upon request.

Water Filters
Vertical and Horizontal Pressure Type....Bulletin 501
Chemical Softeners
Hot Process Water Softener .....Bulletin 504
Cold Process Water Softener for Railroads . Bulletin 506
Continuous Cold Process Water Softener..Bulletin 507
Zeolite Softeners
Zeolite Water Softener for Industry.....Bulletin 509
Zeolite Water Softener for the Home..Bulletins C, D S.
Swimming Pools
The Water Supply for Swimming Pools....Bulletin 500

The Graver Guarantee, united with
Graver Quality, is one you can depend on.

A. I. A. File No. 29 d 32

low
B Mineral
e your home

...mer gives any home
...lite (or "Zeolite")
...ling, with all its ad-
...preserved, and with
...ments never before
...c water softeners.

...olite and how it works
...one. The sand-like
...ntifiable and peculiar
...ought in contact with
...ntaneously, when
...ng "hard" minerals
...Zeolite, that grain ab-
...amount of hardness,
...ough grains are present
...hardness will be re-
...e water absolutely soft.

...er a while, the Zeolite
...l to capacity with the
...ess. But here it shows
...g quality.

...lt water is run through
...mediately lets go of the
...taken on, allowing it
...way. And once more
... material is ready for
..., without a bit of its
...gone.

...ating process, in the
...s necessary only about

How the Zeolite also FILTERS the water

...Being in the form of sharp grains, which
...lets the water pass through, the Zeolite
...in a Grover Softener acts as a fine
...filter, too. It filters out every
...particle of dirt, suspended matter, etc.,
...is removed. The water is always clear
...and sparkling. All of the fine and sus-
...pended matter removed from the water
...and retained on top of the bed of
...softening material is expelled from the
...softener to the sewer by "backwashing."
...This is done while the softener is being
...reconditioned and is accomplished by
...reversing the flow of water so as to
...pass it upward through the bed as is
...shown in the middle illustration on
...the next page.

No other Softener has all these features

A generation of experience in building large industrial water softening plants has taught Grover engineers that certain features are absolutely necessary on any softener, if it is to do its work properly.

So every one of these features has been retained in the Grover Domestic, despite the low cost at which it is now sold.

For example, every outfit is tested and guaranteed to stand a hydraulic pressure of 200 pounds per square inch on the tank, and 125 pounds in the pipe coils. Here is absolute assurance against leaks caused by excessive pressure.

This testing outfit is another handy feature. It tells you, in half a minute, whether the Zeolite needs salting.

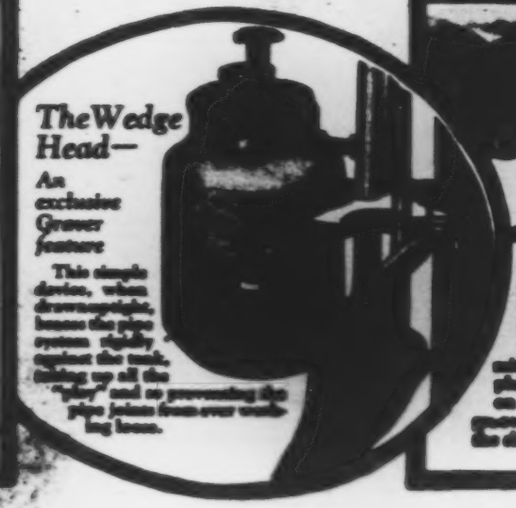
Add only the Grover gives you water down while regenerating. By adding one more valve to the usual number, it lets you keep water flowing throughout the house even while the softener is "cut out" for regenerating.

All outer surfaces are coated with a special gray lacquer, which is impervious to water or brine, and prevents corrosion.

Note all the other important points illustrated here. Compare them, point for point, with any other device, and use for yourself that "it's good judgment to select a Grover!"

...can't get

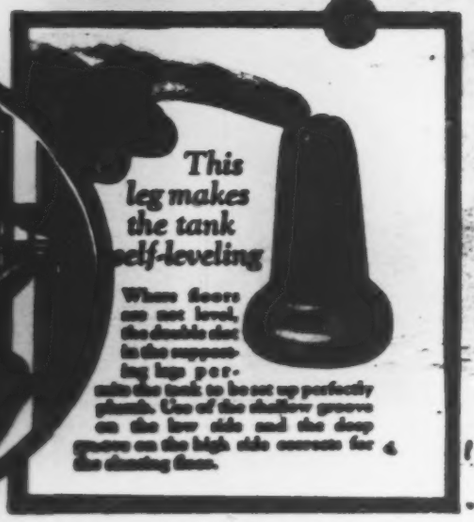
...ily
...d on
...neath,
...reach
...he salt
...ervice
...Grover



The Wedge Head—

An exclusive Grover feature

This simple device, when drawn upright, leaves the pipe system slightly against the tank, taking up all the "play" and so preventing the pipe joints from ever working loose.



This leg makes the tank self-leveling

Where floors are not level, the double slot in the supporting leg permits the tank to be set up perfectly plumb. Use of the shallow groove on the low side and the deep groove on the high side corrects for the sloping floor.

It couldn't be simpler!

Just two things to do—

Set the Valves as required and fill the Salt Pot every week or so

You may think, at first sight, that this is a complicated mechanism. But as a matter of fact, it is most simple.

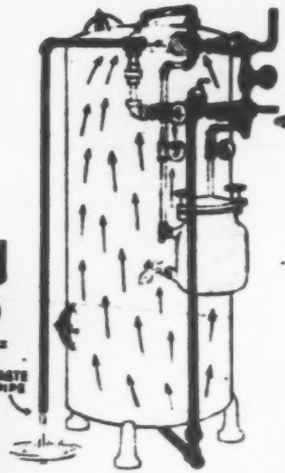
When in service, No. 1 and No. 2 valves are left open; the others closed. And the softener doesn't have to be touched for a week or so.

When it's time to "backwash" and recondition, all that's needed is to fill the salt pot and set the valves as shown in the two illustrations below.

In the three illustrations on this page, open valves and working pipe lines are shown in black; closed valves and inactive lines are in gray

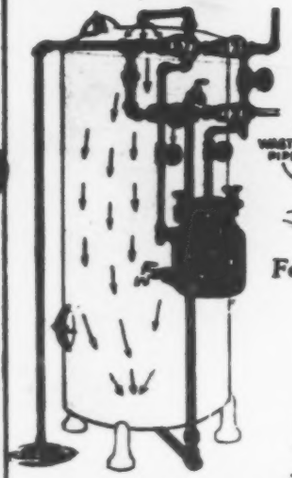
Valves are set in a minute

For Service



WASTE PIPE

For Backwashing



For Reconditioning the Zeolite (Salting)

Salt Pot is Easily Filled

—and that's all there is to do

The Graver Water Softener

is shipped ready to set up

Here's a photograph of a Graver Domestic outfit ready to ship.

The Zeolite and gravel are in plainly marked bags. The pipe and valve system is completely assembled, ready to connect to the tank. Installation is, therefore, a very simple job.

The outfit is sure to reach you in good condition, too. It is packed in a crate so strong that it can stand a 12-foot vertical drop without breaking or damaging its contents.

GENERAL INFORMATION

Size	Floor Space	Height	Size of Pipe	WEIGHT			Maximum Rate Per Minimum Gallon	Minimum Backwash Rate Reg'd Gallon	Amount Salt Required
				Crate 2nd Class	Bags 4th Class	Total			
S-13	14"x20"	5' 6½"	½"	300	295	595	3 5	4	6 lbs
D-1½	20"x31"	5' 4"	¾"	400	1010	1410	7	8	11 lbs
D-2	26"x38"	5' 4"	¾"	500	1575	2075	12 5	10	25 lbs
D-2½	32"x48"	5' 4"	1"	710	2455	3165	20	16	40 lbs

CAPACITY

In Gallons of Water Softened Between Regenerations

Hardness in Grains of Raw Water Per Gallon	S-13	D-1½	D-2	D-2½	Hardness in Grains of Raw Water Per Gallon	S-13	D-1½	D-2	D-2½
4	1965	4375	7895	12680	28	280	620	1125	1800
6	1310	2920	5280	8450	30	260	580	1050	1680
8	985	2185	3935	6345	32	245	545	995	1575
10	785	1750	3150	5075	34	230	515	925	1475
12	650	1460	2630	4230	36	215	485	875	1375
14	560	1250	2250	3620	38	205	455	825	1335
16	490	1100	1970	3160	40	195	435	785	1265
18	435	970	1750	2800	42		415	750	1210
20	390	875	1575	2525	44		395	715	1150
22	355	795	1425	2300	46		380	685	1105
24	325	730	1315	2100	48		365	653	1050
26	300	670	1165	1950	50		350	630	1015

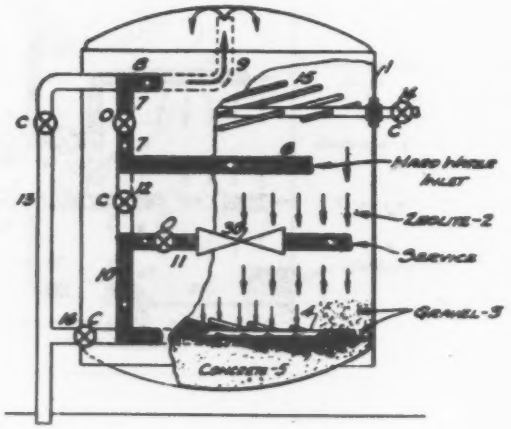
* Type "S" Softener is fully described in another bulletin.
* These sizes are equipped with combined air and water "backwash"

Phone 8245

C-243

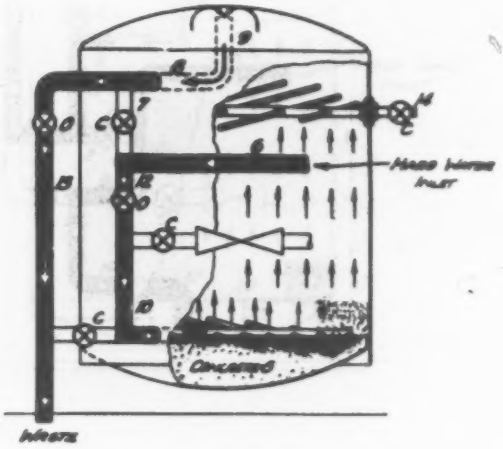
PLTFF'S EX. 14, GRAVER '23

① SOFTENING

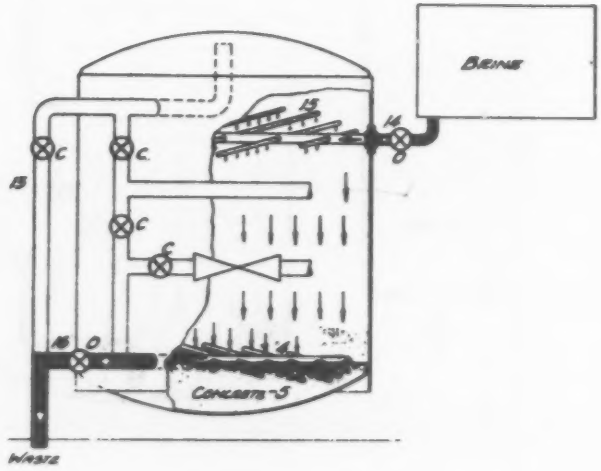


O = OPEN
C = CLOSED

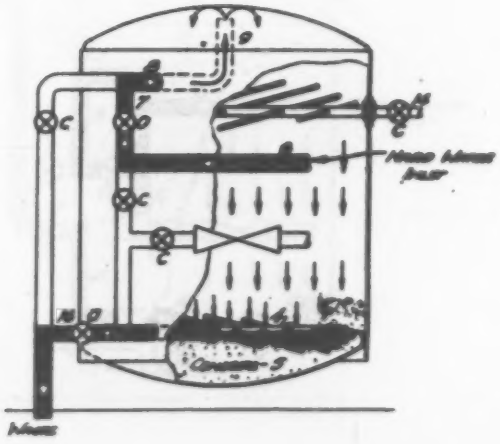
② BACKWASHING



③ REGENERATING (INTRODUCING BRINE)



④ REGENERATING (RINSING)



PLAINTIFF'S EXHIBIT 6

THE PERMUTIT CO
NEW YORK CITY

C-243

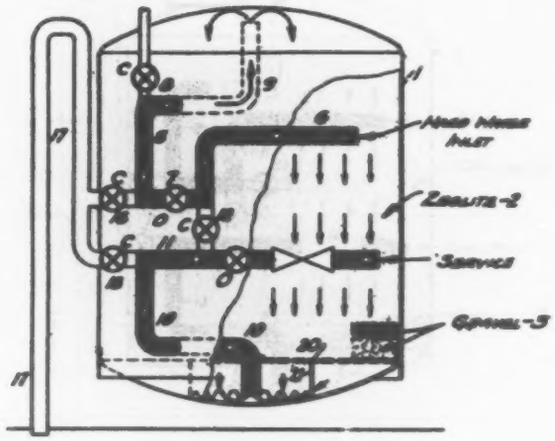
C-242

PLTFF'S EX. 15, GRAVER '25

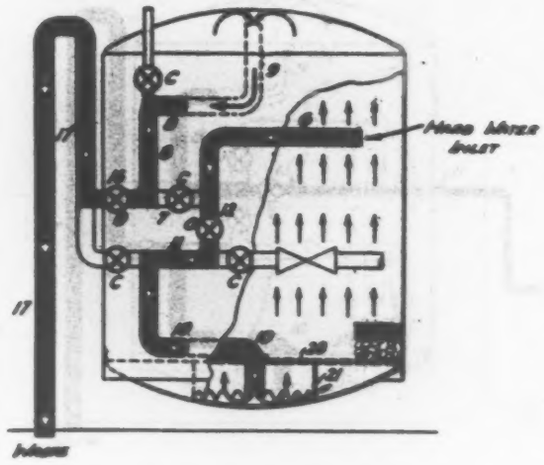
PLAINTIFF'S EXHIBIT 7

① SOFTENING

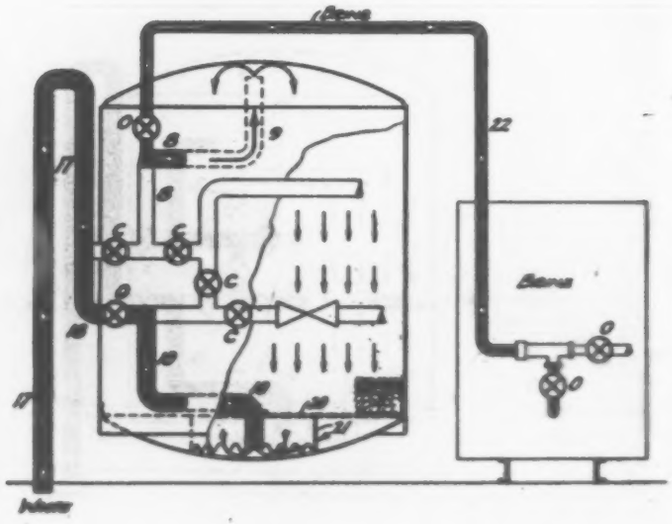
O = OPEN
C = CLOSED



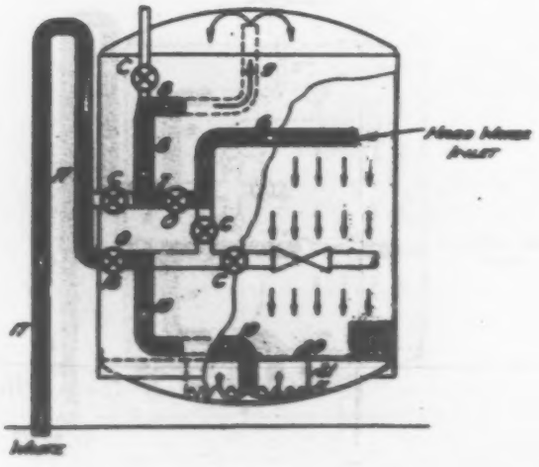
② BACKWASHING



③ BACKWASHING (INTRODUCING BRINE)



④ REGENERATING (BRINING)



THE PERMUTIT CO.
NEW YORK CITY

C-242

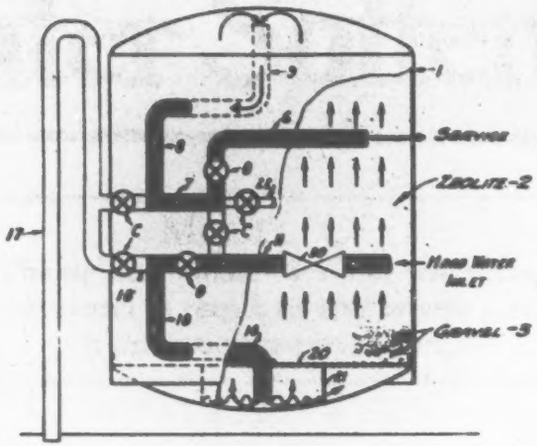
C-240

PLTFF'S EX 16, GRAVER '27

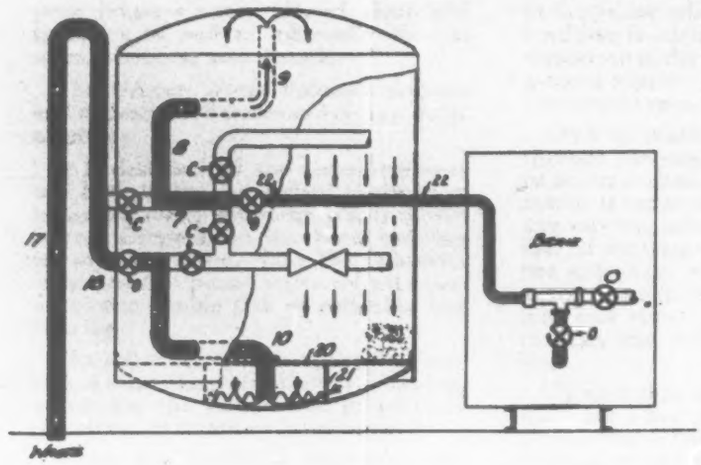
PLAINTIFF'S EXHIBIT 8

(1) SOFTENING

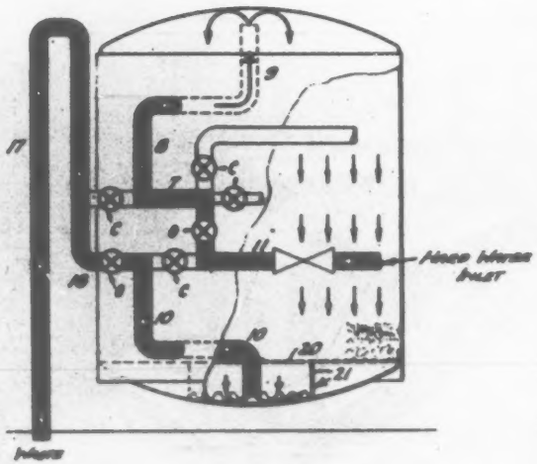
O - OPEN
C - CLOSED



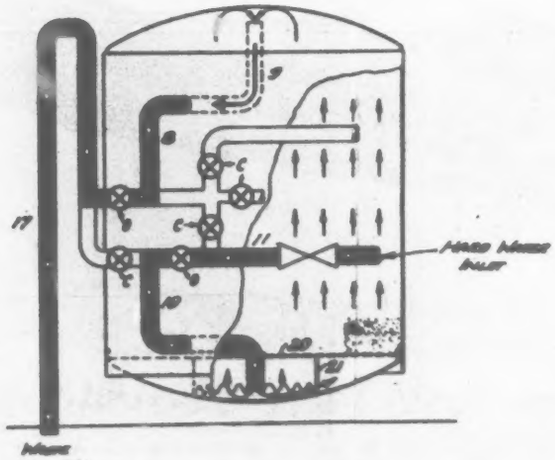
(2) REGENERATION



(3) WASHING



(4) RE WASHING



THE PERMUTIT CO.
NEW YORK CITY

C-240

Chicago Prem Show Nov 4-

PLAINTIFF'S EXHIBIT 9

The GRAVER Domestic Water Softener

MODEL "C"

The de luxe model—for use wherever soft water is required and where ease in operation is paramount.

Built by
GRAVER *Corporation*
ESTABLISHED 1857
Builders of Every Type of Water-Softening Equipment
EAST CHICAGO, INDIANA

A Water Softener that Filters as it Softens available in the newly developed De Luxe Model

Model "C" is designed with the salt tank especially for ease in operation.

Water that is softer and cleaner than raindrops, ready to flow from every faucet in your house — water filtered clear and sparkling as well as softened — all you want, whenever you want it.

The Graver Water Softener puts an end to every hard water and cistern water trouble.

It is designed by the same engineers and built in the same plant as the large industrial water softening plants which Graver Corporation has been building for so many years. Like the industrial softeners, this home water softener performs the double task of softening and filtering.

The softening agent is a granular mineral of sand-like grains known as Zeolite, which has the remarkable property of absorbing all hardness from water.

When the Zeolite is saturated with hardness, a solution of common salt flowing through it washes all of the absorbed hardness out of the softener to the sewer. With the model "C" softener described in this folder—the salt for washing out the hardness is contained in a separate tank connected to the softener, holding several months supply. This makes it most convenient for removing the hardness.

Only by passing the water downward through the softening bed can filtration be accomplished. All dirt and suspended matter is removed without impairing in any way the softening action of the Zeolite. If the water passes upward through the softener, its entire contents are agitated and in suspension. This allows dirt and other impurities to pass on through the softener into the service line.

Upward flow of water is used periodically for a few moments in operating a Graver Water Softener to remove the dirt retained by the filtering action. This is called "backwashing" (cleansing) and is described on pages 6 and 7.

Every drop filtered crystal clear and 100% pure

The GRAVER Water Softener

Here's the GRAVER *De Luxe Process*

1 *As hard water enters the softener at the top, it immediately strikes the DEFLECTOR which breaks up the stream.*

This distributes the water evenly over the entire surface of the softening material. The deflector also aids in preventing any softening mineral from being washed out during backwashing.

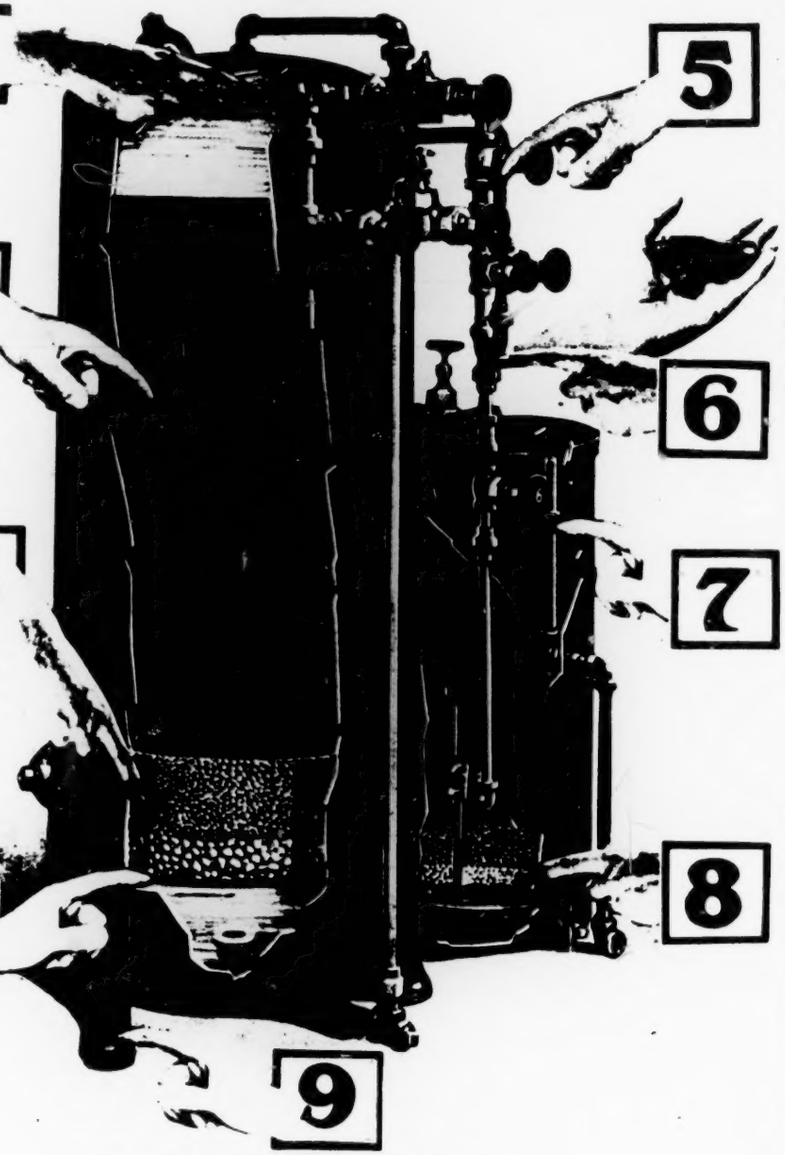
2 *The Softening Mineral, ZEOLITE, then does the softening and filtering.*

This remarkable material, formed by nature and processed by Graver Methods, absorbs everything that makes water hard. It softens indefinitely, the salt from the salt tank regenerating it as soon as it becomes "over loaded" with hardness. Then too, Zeolite is a filtering medium, mechanically removing from the water all dirt and suspended matter. Water passing through this softener is not only soft but crystal clear.

3 *Two layers—one of crushed quartz, one of gravel support the Zeolite bed.*

These two layers prevent the Zeolite from being washed through the softener into the pipes. In backwashing they aid in diffusing the water throughout the entire bed.

4 *The Supporting Plate* supports the entire contents of the softener. Through small equally spaced holes in this plate, the water flows to the outlet pipe ready for use. And too, in backwashing, these holes distribute the water over the entire bed.



5 *These easily reached valves control every operation.*

Each globe valve is absolutely tight, yet very easy to operate. The soft rubber disc lasts indefinitely—but if it wears out it can be renewed in a minute. The valve seats are of monel metal so will not corrode or rust out. These valves will not leak at the stem.

To operate a Graver Softener, all you have to do is to set these plainly numbered valves as instructed. The natural flow of water does the rest.

6 *This EJECTOR* is the heart of the operation of this softener. Water flowing through the Ejector creates a suction which draws the salt solution from the salt tank into the softener rejuvenating the mineral. There is no salt to weigh out—no covers or lids to remove—just turn the valves letting the water flow through the ejector.

7 *Salt Charge Marker* shows when sufficient salt solution has been drawn into the softener from the salt tank. It is permanently fastened to the pipe as shown, so is always accurate.

Testing Equipment

is furnished with each softener. It is very simple to use—just add a few drops of the testing solution to water from the softener in a bottle and shake. Enough testing solution is furnished to last many months.

8 *Gravel in the bottom of the Salt Tank* allows nothing but the salt solution to leave the tank. This allows accurate and economical salting which would be impossible if undissolved salt were in the salt solution. The gravel also filters the salt solution.

This Backwash Rate Controller

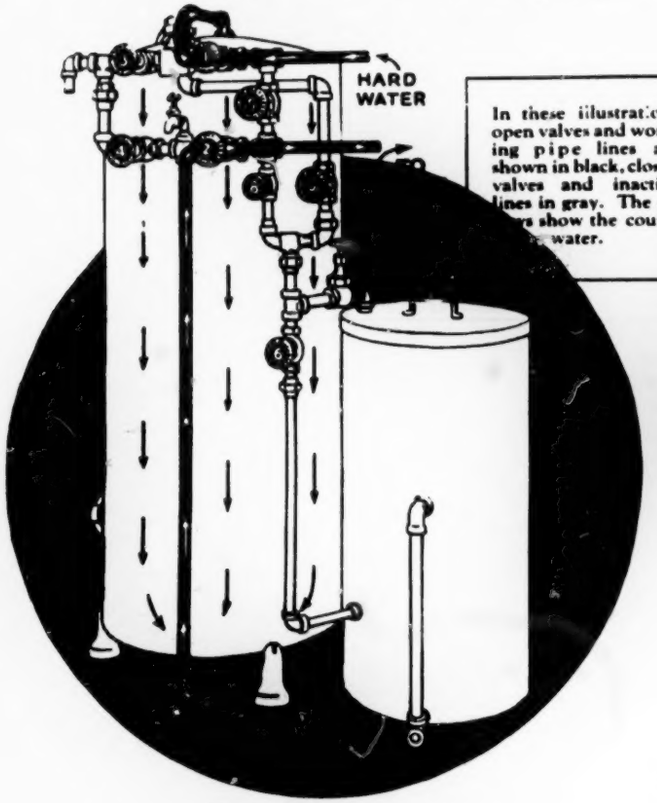
attached to the end of the Waste Water line effects complete washing with no loss of mineral. The rate of flow is so adjusted (by turning valve 2) that the backwash water is even but not overflowing the top of the controller. This will give sufficient agitation, at any pressure, to wash out all dirt and sediment, but not enough to carry any Zeolite out of the softener to the sewer.

9 *This leg makes the tank self leveling.*

The double slot in the supporting legs permits the tank to be set up perfectly plumb, even on uneven floors.

Operating a GRAVER Model "C" Softener Couldn't be Easier

Just One Thing to Do
Set the Valves as Required—

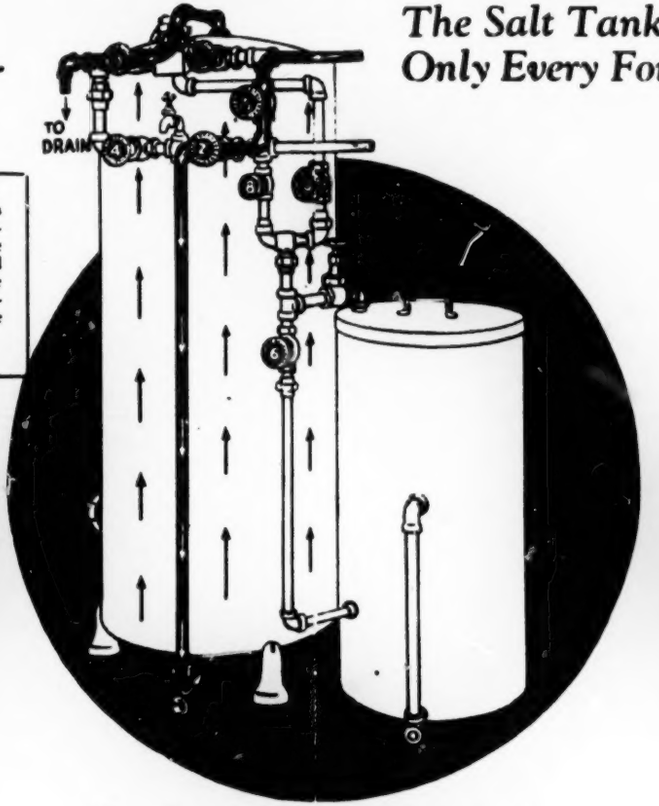


In these illustrations open valves and working pipe lines are shown in black, closed valves and inactive lines in gray. The arrows show the course of water.

For Service

The Graver Water Softener is most simple. When in service it requires no attention. All valves are closed except Nos. 1 and 2 which cause the hard water to run into the tank at the top, flow downward through the softening material and out to service through valve No. 2.

When put in service, the softener doesn't have to be touched for a week or so and then but a few moments to "backwash" and recondition (salt) as shown in the two illustrations on the right.



"Backwashing" (Cleansing)

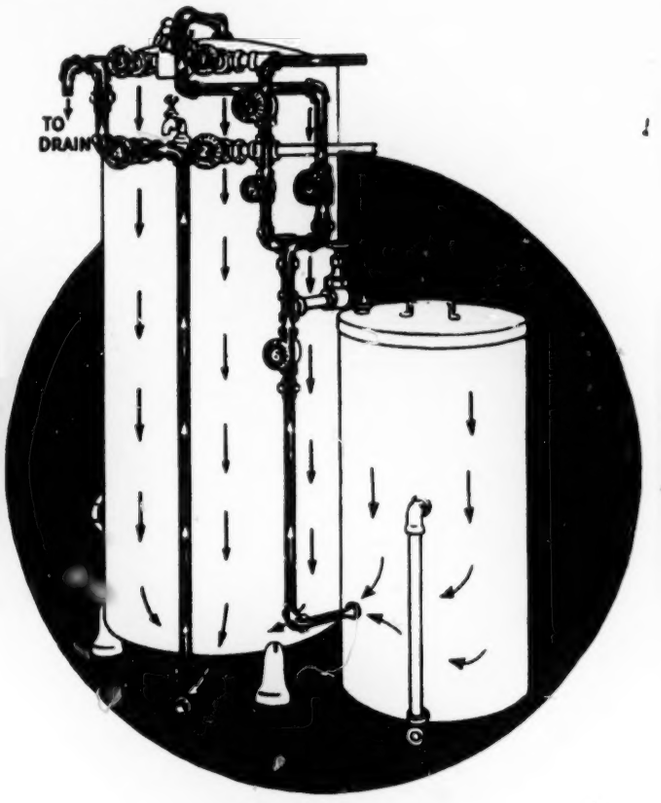
At the end of a run when the softening mineral is loaded to capacity with absorbed hardness the softener is "backwashed". This is done by reversing the flow of water, running it into the bottom of the softener, up through the softening material and out through the top to the sewer.

The main reason for backwashing is to wash out the accumulated sediment which has been filtered from the water but the operation also thoroughly agitates the entire bed so that it is the same density throughout. This is very essential for efficient softening and filtering.

"Backwashing" is simple and requires no labor—takes but a few moments and leaves the softener ready for the next operation—Salting.

Your water supply is never shut off even during regeneratio. The special valve arrangement gives y. water in the house even if the softener is out of service.

The Salt Tank Needs Refilling
Only Every Four to Six Months



Salting

Simply diverting the flow of water through the ejector picks up the salt solution from the salt tank and forces it through the cleaned Zeolite mineral. This causes the Zeolite to give up all its absorbed hardness and brings it back to its original softening properties. The action is instantaneous, it is not necessary to leave the salt in contact with the Zeolite for hours or over night.

Notice how simple it is to add the salt. No weighing or measuring is necessary. Turn the few valves which lower the level of the salt solution and that is all.

One filling of salt will last from four to six months.

GENERAL INFORMATION

Size	Floor Space	Height	Size of Pipe	SHIPPING WEIGHT			Maximum Rate Per Minute	Minimum Backwash Rate Required
				Crates 2nd Class	Bags 4th Class	Total	Gallons	Gallons Per Minute
C-1½	31"x41"	5'-5"	¾"	625#	675#	1300#	7.0	8
C-2	38"x45"	5'-6"	¾"	750#	1150#	1900#	12.5	10
C-2½	45"x57"	5'-9"	1"	1230#	1870#	3100#	20.0	16

CAPACITY
In Gallons of Water Softened Between Regenerations

Hardness of Raw Water In Grains Per Gallon	C-1½	C-2	C-2½	Hardness of Raw Water In Grains Per Gallon	C-1½	C-2	C-2½
4	4375	7895	12650	28	620	1125	1800
6	2920	5250	8450	30	580	1050	1680
8	2185	3935	6345	32	545	995	1575
10	1750	1150	5075	34	515	925	1475
12	1460	2630	4230	36	485	875	1375
14	1250	2250	3620	38	455	825	1335
16	1100	1970	3160	40	435	785	1265
18	970	1750	2800	42	415	750	1210
20	875	1575	2525	44	395	715	1150
22	795	1425	2300	46	380	685	1105
24	730	1315	2100	48	365	653	1050
26	670	1165	1950	50	350	630	1015

Model "D"

This model is built on the basic principle of Model "C" except that the salt is introduced through the pressure feeder attached to the pipe nest. It is made in the same sizes and delivers the same amount of soft water between regeneration as Model "C". Complete information can be obtained from your dealer.

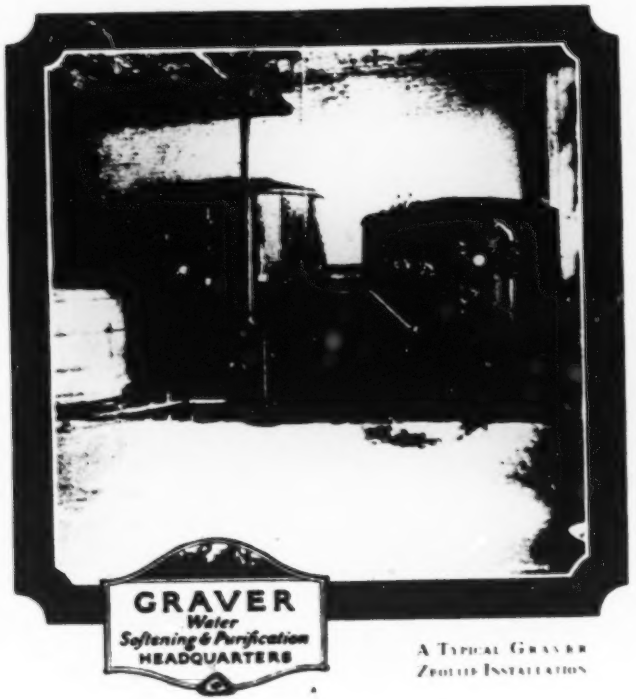
Model "S"

This model is built in one size only—13" in diameter. It differs from Model "C" and "D" in that the salt is introduced through the funnel on top of the softener. This model should be used only where requirements for softened water are small, such as barber shops, beauty parlors, automobile service stations, offices, etc. Complete information can be obtained from your dealer.

Tuffs Ex. 3 C

3980

The GRAVER Zeolite Water Softener



A TYPICAL GRAVER ZEOLITE INSTALLATION

The softening agent employed in water softening plants is an artificially produced mineral substance, similar in nature to a number of zeolites found in a natural state, but which is produced in a form of higher and more uniform purity by the Graver process.

The mineral zeolite is what is known as an "exchange silicate," and this substance has an almost magical property of softening water that is passed through a body of it. This material, furthermore, will reduce water hardness to the absolute zero point.

After a period of continuous action, zeolite requires restoration. This is accomplished by submerging the zeolite with a salt solution which is run into the softener from a salt solution tank. The process is automatic, requiring but a few hours at night, and it leaves no salt solution in the softener.

The Graver Zeolite Water Softener is the result of many years of research and development by engineers who have studied and built water softeners for fifteen years, and Graver Zeolite is produced in our own manufacturing laboratory. For it, may [illegible] degree of mechanical strength, so that its original granular form is retained, highest "exchange" properties, and a reactive susceptibility that causes it to regenerate rapidly with a moderate amount of salt solution.

It can be readily seen, that while the savings in money effected by a Graver Softener on soaps and dyestuffs is considerable, these savings do not begin to compare with the greater values imparted to the quality of the product itself. Textiles that are consistently and uniformly soft and velvety to the touch, evenly dyed and brilliantly colored, constitute an asset in salability that can only be measured in repeat orders from the trade. Our literature on the Graver Zeolite Water Softener will serve to show, in this connection, how the foregoing results are readily obtainable.

We invite inquiries regarding this softener from executives interested in the manufacturing [illegible]. Bulletins containing full information will be sent you upon request. Our representative from our office will call upon you at your convenience without any obligation whatsoever [illegible]

PLAINTIFF'S EXHIBIT 10

Depositions for Plaintiff Stipulated from Detroit (Wadham) Case.

SHERIDAN S. NORTON, a witness for plaintiff in *prima facie*, testified March 3, 1919, as follows:

My name is Sheridan S. Norton. I am 45 years old, residence 850 Park Ave., New York City; am vice-president and treasurer of the Permutit Co., have been connected with Permutit Co. since organization in 1913, and as an officer since Dec. 3, 1913.

The Permutit Co. took over a concern known as the Permutit Syndicate which had succeeded to the rights of the Riedel Actiengesellschaft in and to the Gans apparatus patent which is one of the patents in suit. The Riedel Co. had an agency in this country and sold a very few plants. The Permutit Syndicate also sold a few.

The first plant for softening water by the use of base exchange silicates or zeolites was installed in this country at the Berkshire Knitting Mills, Reading, Pa., in early part of year 1911.

Immediately after the organization of the Permutit Co. it built a large factory at a cost of over $150,000. It has and does maintain a large staff of consulting engineers to advise prospective customers as to the particular kind of water softening plants they may require. In addition to this, the company has advertised extensively in various papers and has also prepared and sent out literature and pamphlets to explain the merits of its system from a scientific standpoint. During the first two years of the company's existence it spent over $200,000 in selling and introductory costs alone. During this period, the company ran at a considerable loss. It has expended in introductory and selling costs up to the present time (March 3, 1919) a little over $700,000.

The Permutit Co. had no competition until the year 1916. The system was practically unknown in this country until the Permutit Co. through its efforts had succeeded in bringing before the manufacturing world the merits of its system.

CROSS EXAMINATION:

This is a suit founded on infringement of patent and not based upon unfair competition in trade. The Riedel Actiengesellschaft is a corporation of Germany. I do not know to what extent that corporation had installed zeolite water softening

filters covered by the Gans patent in Germany before installation of first plant in this country. Permutit is a trade-mark or trade name for the water softening substance and is also used on apparatus. At time of organization of the company in 1915, the only water softening substance used in these filters was an artificial zeolite. I do not know of Permutit Co. marketing any natural zeolite. I do not know whether the artificial zeolite which the Permutit Co. has manufactured and marketed to date has been made to some extent under certain Gans patents for methods of producing artificial zeolites. The Permutit Co. owns Gans patents for methods of producing artificial zeolites. I do not know whether the packages containing the permutit is marked with the dates or numbers of any of the Gans patents for methods of producing artificial zeolites.

SAMUEL B. APPLEBAUM, a witness produced for plaintiff, in *prima facie*, on March 3, 1919, testifies:

My name is Samuel B. Applebaum, my age 28, residence 259 E. 182nd St., New York; am engineer for the Permutit Co. since June, 1913. I took a course in civil engineering, including chemistry and special courses in water purification at Columbia University, receiving degree in 1913. The business of the Permutit Co. is the manufacture and sale of water purification plants. The trade-mark "Permutit" is applied to all its products. Among other things, it produces zeolites or base exchange silicates for the purpose of removing hardness from water.

The term "hardness" as applied to water is used to mean those compounds of calcium and magnesium which constitute the hardening elements in the water. If the calcium and magnesium is combined with carbonic acid the hardness is generally termed "carbonate" hardness. If the calcium and magnesium is combined with any other acid, such as sulphuric acid, or hydrochloric acid, then the hardness is usually called non-carbonate hardness.

If the calcium and magnesium is combined with one molecule of carbonic acid, the hardness is then called "monocarbonate hardness", and if it is combined with two molecules of carbonic acid, the hardness is called "bicarbonate hardness." The bicarbonates of calcium and magnesium differ from the monocarbonates in that they are soluble in water and the monocarbonates are insoluble in water. When a bicarbonate of calcium, for example, is dissolved in water, and heat is applied one of the molecules of carbonic acid is split off resulting in a

monocarbonate which being insoluble in water precipitates from the water. The non-carbonate hardness, such as the chlorides and sulphates of calcium and magnesium differ from the bicarbonates in that the application of heat causes no chemical change and they still remain soluble in the water. This difference between the two is often designated by calling the non-carbonate hardness "permanent" hardness, and by calling the carbonate hardness "temporary" hardness.

Rain-fall is practically distilled water. But as it falls through the air it absorbs carbonic acid which is present in the air either due to plant life or due to the burning processes resulting in smoke escaping from stacks or due to decaying processes. This carbonic acid is very soluble in the rain, and as the rain percolates through the earth it comes in contact with rocks of all sorts, among them being limestones. The carbonic acid in the rain water attacks the limestone, forming bicarbonates of calcium which are carried away in the ground water. The same reaction takes place when the rainfall comes into contact with magnesium carbonate. If the rain water strikes deposits of the chlorides or sulphate of calcium or magnesium it readily dissolves these and in this way the various compounds constituting the hardness of water find their way into the usual sources of supply.

The French, English and German have their own way of measuring hardness in water, but they are all based upon the common measurement of expressing the hardness in so many parts of calcium carbonate or its equivalent in a million parts of water. The American method of designating hardness is to state it in grains per U. S. gallon, and one grain per gallon is equal to 17.1 parts per million of calcium carbonate or its equivalent. A water of zero hardness has of course no calcium carbonate in solution.

Various laboratories may have special methods of their own for the determination of hardness in water. The usual method employed, however, is to place a definite quantity of the water to be tested in a receptacle, such as a glass bottle, and to drop small amounts of a standard soap solution into this receptacle and to shake the soap solution and water together to see whether a permanent lather is formed. The soap is continued to be dropped in small amounts into the receptacle and shaken each time until such a permanent lather results, and a permanent lather is one which will stand up five minutes without the bubbles breaking. Tables are printed which give the hardness when the amount of soap used is known for a definite quantity of water used in the sample. On these tables it will be found

that a water has no hardness when .7cc of standard soap solution added to 50cc of the water sample result in a permanent lather. The Permutit Co. in its field testing employs a stronger solution of soap than in the laboratory, and this is known as standard B. & B. soap solution (Boutron and Boudet). When two drops of this soap solution are added to 40cc of the water sample and when a permanent lather results the water has no hardness or zero hardness.

Aside from distillation which is too expensive to be practical on a commercial scale, there were no known apparatus for producing a water of zero hardness, prior to the introduction of the zeolite process by the Permutit Co. There were, however, methods of water softening in existence which resulted in a partial reduction of the hardness, and these are often called the precipitation processes. They all employed chemicals such as lime, soda ash, caustic soda, barium carbonate, either alone or in combination, adding them to the water in amounts depending upon the chemical composition of the water.

The theory upon which such apparatus works is that by the addition of these chemicals to the water the hardening elements are changed in form, changing them from a soluble form to an insoluble form of calcium and magnesium compounds. By so doing, the calcium and magnesium are partially precipitated from the water and may be allowed to settle out and be filtered from the water. For example, if you have calcium bicarbonate in the water and you add lime, the calcium of both the bicarbonate and the lime combine to form a new compound which is a mono-carbonate of calcium which is insoluble and precipitates out from the water.

The precipitation apparatus may vary in detail, depending upon the design, but in general all the designs have in common the measuring of the hard water, the measuring of the chemicals to be added, apparatus for the mixture of the chemicals and hard water, a settling tank or tower in which the resulting precipitates may be allowed to settle, and a filter to remove any of the precipitates which have not been completely settled out. I produce a drawing which illustrates generally the construction of such a precipitation apparatus.

Referring to this drawing, the hard water enters the plant through pipe 1 shown on the left of the drawing. It then flows into the hard water box 2 located directly over the water wheel. The main stream of raw water then flows through the water wheel thereby generating the power to turn the paddles in the mixing chamber and in the chemical box. I mark the waterwheel 3, the chemical tank 4, the paddles in the chemical tank

5, and the paddles 6 in the mixing chamber. After leaving the water wheel the hard water flows through the spout 7 where it meets the stream of chemicals from pipe 8, being thoroughly admixed with the chemicals by the motion of the stirrer or paddles 6. The precipitates formed then fall with the stream of water down through the mixing chamber to the bottom of the settling tower. The stream of water then turns upward around the outside of the mixing chamber, thus allowing the precipitates to fall away to the bottom. The water then passes through a filter where any precipitates which have not settled are removed and the filtered and softened water enters the filtered water chamber above the filter. It is then drawn off through the water outlet pipe 9 and away to service.

As a rule, the time of reaction which depends upon the composition of the raw water should be at least four hours, so that the size of the settling tower must be sufficient to contain a four hour supply of water. For example, if the rate of flow through the plant is ten thousand gallons per hour, the settling tower has to be 40,000 gallons in capacity.

The control of the chemical feeding device is as follows: A small stream of raw water from the hard water box 2 flows through pipe 10 into the top of the chemical tank 4. There it is mixed with the contents of the tank by the mixer or paddles in the bottom of the tank driven by the water wheel. When the chemical tank fills up, it overflows out through the pipe 8 into the mixing chamber. It is apparent that if the stream of hard water entering the top of the chemical tank through pipe 10 were constant in amount that after a while the strength of the solution of lime and soda ash in the chemical tank would gradually weaken, as, for example, after two hours the strength of the solution would be very much weaker than at the beginning of the run. This would result in an under-treatment of the water because the amounts of chemicals must be directly proportional to the amount of hard water flowing through the tank. To correct this, a cone plug valve 11 is located in the opening to pipe 10 in the bottom of the hard water box. This cone valve is operated by a chain 12 connected to a float lever 13 in the water measuring tank 14. A small stream of hard water flows from the hard water box 2 through pipe 15 into this water measuring tank. At the beginning of the run the water measuring tank is empty, but during the run this small stream of hard water flowing through pipe 15 which is always a definite fraction of the main stream through the water wheel causes the float 16 to rise in the water measuring tank in pro-

portion to the amount of water which is passed through the water wheel. This operates the cone plug valve 11, raising it and thus permitting a larger and larger stream of hard water to flow through the pipe 10 into the chemical tank. By so doing, a larger amount of a weaker solution of lime and soda ash is allowed to overflow through pipe 8 into the mixing chamber until at the end of the run there is practically a negligible strength of lime and soda ash in the chemical tank, at which time it is necessary to make a new charge of chemicals.

To assist the attendant in knowing when it is necessary to make a new charge there is a measuring scale and indicator 17 connected by means of a chain 18 to a float 19 in the aforesaid water measuring tank. When the water measuring tank fills up, float 19 rises and lowers the indicator until it reaches the end of the scale when the attendant knows the time to make a new chemical charge.

The drawing produced by the witness is offered in evidence and marked "Plaintiff's Exhibit 4 Typical Precipitation Plant".

Exhibit and testimony concerning it is objected to as irrelevant and immaterial.

It is agreed between counsel that this objection stands to all questions along this line.

The very greatest objection to a precipitation plant is that it does not produce a water of zero hardness. The best that can be obtained by a lime-soda plant is a hardness running between four and five grains per gallon, expressed as calcium carbonate, and as a rule the hardness runs very much higher than that. The difficulties in the operation of such a plant are mainly in the measuring of the raw water and the chemicals. As a rule, the devices for these measurements are too crude for precision, and, furthermore, the measuring of the chemicals give great difficulty because the chemicals themselves incrust the measuring surfaces, and so in time cause an error in the treatment. Furthermore, the measuring devices themselves get out of order and as they are complicated in construction it is very difficult to repair them.

If too little chemical is added to the water the result is an undertreatment of the water, leaving the greater part of the hardness not removed. On the other hand, if too much chemical is added, the result is an over-treatment which means that the excess of chemicals added remain in solution in the effluent from the plant which may in turn mean that more hardness

has been added than was originally contained in the water and at the same time that the softened water is extremely caustic.

Variations in the raw water complicate the operation of a precipitation plant and make necessary very careful chemical analysis of the raw water at all times to make sure that the charges of chemical are proportioned correctly to the composition of the water. Raw waters vary very widely in hardness. We have installed Permutit water softening plants where the raw water has a hardness as low as one and half grains and in other cases where the hardness may go up to as much as 100 grains per gallon.

The usual sources of supply of water are made up principally of surface water and ground water in combination. This applies to sources from a pond, spring, well, river, or stream. The ground water has usually traveled a great distance through rocks and therefore has much more opportunity to pick up hardness. The surface water on the contrary has not come into great contact with deposits of hardness and is, therefore very much softer than ground water. In dry seasons, when there has been very little rain, the usual sources of supply have a greater proportion of ground water and a very much smaller proportion of surface water. For that reason, in dry seasons, the hardness of the usual sources of supply goes up considerably. On the other hand, in spring, or when the snow and the ice begin to melt, the usual sources of supply receiving the melted ice grow considerably softer. These variations are not only confined to seasonal changes, but they may be very sudden. After a very heavy rainfall, for example, streams have been known to change their composition suddenly, within a few hours. These sudden changes in the composition of the raw water when treated in precipitation plants would result in incorrect treatment of the water unless the operator had happened to make a chemical analysis of the water when the chemical change was taking place and had made a change in the chemical charge accordingly.

Causticity of the water resulting from treatment in a precipitation plant is very undesirable, and for a great many purposes this causticity has to be neutralized before the water is fit for use.

The operator of a precipitation plant must be versed in chemistry so as to be able to make the necessary chemical analyses of the raw water and be able to calculate the changes in the chemical charges in accordance with these variations in composition of the raw water. The North Dakota Agricultural Experiment Station has devoted a great deal of research to the

problem of the softening of the hard waters. I produce one of their Bulletins, No. 4, Vol. 5, and read from page 83:

> "Providing the exact degree and character of the hardness present in the water is known, the chemist can calculate the precise amount of chemical that it would be necessary to add to get the maximum softening effect possible, and without injuring the quality of the resulting soft water by leaving in it an excess of the chemical added. Putting in too little of the softening agent will not result in a completely softened water. An overdose will result in a soft water but leaves dissolved in it the excess of the softening agent, which is objectionable, because it makes the water unfit for drinking purposes and cooking at least, and sometimes for other uses. Thus, it should be thoroughly understood that no chemical agent can be very successfully added to a water for softening it unless the procedure is based upon complete knowledge of the character of the water to be treated, and under expert supervision. This means a chemical analysis of the water and a recommendation from the chemist."

As a rule, with the average settling tower, of about four hours capacity, the reactions are not entirely completed as the water leaves the plant. The excess of chemicals left in the effluent react with the hardness also left in the effluent and these reactions continue slowly but for a great length of time. These reactions are called "after-reactions," and the deposits which result from the reactions form in pipes, pumps, heaters, and boilers, giving great difficulty because of the necessity for cleaning them.

The zeolite process of softening water by base exchange silicate is entirely different from the precipitation process in that it produces a water of zero hardness. Aside from distillation which is not practical on a commercial scale, the zeolite process is the only one which can produce such a zero water. The operation of the zeolite plant depends upon the power of the zeolites of exchanging their sodium base for calcium and magnesium bases in the raw water. No matter what form the calcium or magnesium compounds may be in, the zeolites remove them completely. The zeolites have, furthermore, the property of being revivified or regenerated after they have exhausted their power of exchanging their sodium for calcium and magnesium. This regeneration is a reversal of the exchange. After a zeolite plant has produced its definite quantity

of zero water, the raw water is shut off and a solution of common ordinary salt, sodium chloride, is passed through the zeolite and the sodium of the salt goes back into the zeolite and the calcium and magnesium previously absorbed comes out from the zeolite and goes off with the spent brine.

The apparatus used in zeolite water softening consists of a casing in which there is a bed of zeolites supported on sand or gravel. This casing is fitted with a pipe connection for the introduction of the raw water and has another pipe connection for the discharge of the zero water. Furthermore, tanks are provided for the dissolving of the salt, and a pipe connection between these tanks and the casing to enable the salt solution to pass through the casing. Furthermore, a pipe connection is provided to allow wash water to rinse the spent brine from the zeolites. Care must be taken that no salt pockets or traps are possible in which salt solution may collect.

Precipitation plants at their best do not reduce the hardness below four or five grains per gallon. On the other hand, the zeolite plants always produce a water of zero hardness. The zeolite plants are very simple in construction and very easy to operate. An unskilled attendant not versed in chemistry can control the operation of a zeolite plant successfully. All that has to be done is to open certain valves during the softening and close these and open other valves during the regeneration. Further, there are no chemicals used in the softening, and therefore there are no devices for the measuring of the chemicals and the usual difficulties with such measuring devices are therefore avoided. Furthermore, there are no precipitates formed and no setting towers are required, and the problem of sludge removal is avoided. Again, the difficulty with variations in the raw water is automatically taken care of by the zeolite plant. The hardness may vary widely up to its maximum for which the plant was designed and yet the zeolite plant will automatically turn out a uniform water of zero hardness at all times. Furthermore, there is no destruction of the zeolites themselves. Slight losses may take place by the escape of zeolites with the wash water, but these are so small that they may be neglected. Furthermore, the zeolite plants are very small in comparison with the precipitation plants. Whereas a precipitation plant must as a minimum have a settling tower of four hours, a zeolite plant may have a capacity of only several minutes and still produce results which are infinitely superior to the precipitation plant. Even with waters that are very hard, it is possible to run through

a zeolite plant in ten minutes, and where the waters are softer the passage only requires a few minutes. This element of space is very valuable, because it means that the zeolite plant can be located in existing rooms of existing buildings and avoids the necessity for expensive foundations and housings. Furthermore, the zeolite plant can operate under pressure and thus may be connected directly into an existing water pipe line, avoiding the necessity for altering an existing water works and repumping. Furthermore, a zeolite plant will produce a water not only of zero hardness but free from causticity. This is a very valuable result, because it avoids the necessity of neutralization.

The term "zero-hardness" is used to describe a water which is absolutely soft. The Permutit Company adopted the term zero hardness to describe the characteristic of the water which its zeolite plant produced. The Permutit Co. was also the first to produce a water to which this term could be applied. The Permutit Co. has also adopted the use of the term "velvet" to describe the peculiar soft feeling specially characteristic of zero water.

There are a very great number of industries or branches of industrial art in which zero water may be advantageously used. Among these may be mentioned principally the textile arts, power plants, laundries, tanning industry, canning, ice manufacturing, the bright metal industry and domestic uses. There are probably others which will be developed as the zeolite industry grows.

In all textile processes, soap is used very extensively for cleaning purposes. The cleaning power of soap depends upon its being in solution. But before it can get in solution, it must react with the calcium present in the water to form insoluble calcium and magnesium soaps which remain suspended in small particles in the water or float on top. These insoluble soaps are familiar to the average user of water in the typical curd and dirty streak around the side of a bathtub. Authorities state that for every grain per gallon of hardness present in the water 1.7 pounds of soap have to be wasted per thousand gallons of water used before the remainder of the soap becomes effective for cleaning purposes. For example, a water containing 10 grains of hardness is very usual. Such a water would cause the waste of 17 lbs. of soap for every thousand gallons of water used. Take the case of a textile plant using 10,000 gallons of water per day in making its cleaning baths. Let us assume that the price of soap is only ten cents per pound.

The present price of soap runs from that figure all the way up to 18 cents. If the raw water has a hardness of 10 grains per gallon, this textile plant would waste in soap alone about $5,000 per annum, which could be saved by the installation of a Permutit plant. The Permutit Co. has found that on the average the use of zero water causes a saving of about 50% in soap. To obtain an idea of what this means, throughout the country, I have looked up the census of manufacturers of 1914. On page 3, it is stated that the value of soap used in the year 1914 was $128,000,000 and at that time the price of soap was probably one-half of what it is to-day.

Counsel for plaintiff offers in evidence Bulletin No. 4, Vol. 5, of the North Dakota Experiment Station referred to in the answer of the witness to Q. 22, as Plaintiff's Exhibit 5, Station Bulletin.

Up to March, 1919, 104 zeolite or base exchange water softening plants had been installed by the Permutit Co. in textile concerns of this country, valued at about $500,000.

Scale is the deposit resulting from the use of hard water in heaters, condensers and boilers of power plants. Where the hardness for example is composed of bicarbonate of lime and heat is applied, one of the molecules of carbonic acid is split off, resulting in the formation of monocarbonates which are insoluble in water and form a deposit in the piping, in boiler tubes and on boiler shells. I produce a sample of a pipe line filled with such deposit taken from the hot water piping system of the French Lick Spring Hotel, French Lick, Ind. Scale is not only formed by the bicarbonates of calcium and magnesium, but in the case of boiler feeding, scale may result from the use of water containing chlorides and sulphates of calcium and magnesium. As the raw water is continually fed into the boilers and steam is generated, the compounds contained in the original water are left behind and gradually cause the boiler contents to grow concentrated. When the limit of solubility of the non-carbonate hardness is reached, these compounds begin to precipitate out and form a very hard and compact scale. I produce a sample of such scale taken from one of the boiler tubes of the Pennsylvania Steel Co. of Steelton, Pa. Another typical form of scale is caused by small flakes falling down into the lower parts of a boiler and becoming cemented together. I produce a typical formation of this kind, taken from the lower part of a large boiler.

The samples of scale produced by the witness are offered in evidence and marked, respectively, "Plaintiff's Exhibit No. 6 Hot Water Pipe Scale"; "Plaintiff's Exhibit No. 7 Boiler Tube Scale" and "Plaintiff's Exhibit No. 8 Flake Scale."

A very serious disadvantage and perhaps the one least appreciated is the waste of fuel, or, putting it another way, the loss of heat, due to the formation of scale. A boiler is constructed not only so that the immediate heating effect of the burning fuel is utilized but every effort is made to cause the hot gases or products of combustion to circulate back and forth through the pipes of the boiler so that all the heat which the products contain may be utilized. The steel of the boiler tubes and boiler sheets is a very good conductor of heat so that the heat from the gases passes rapidly through the walls of the tubes and heats the water to generate steam. Scale, however, is a very poor conductor of heat, and if the boiler tubes and sheets are coated on the inside with the deposit of scale this scale prevents the passage of heat though the walls of the tube and sheets and into the water. The products of combustion, therefore, are incompletely utilized and they pass off up the stack carrying with them heat units which would otherwise have been effective for steam producing purposes. This loss of heat, or to put it another way, the loss in fuel due to scale, is very large. In the recent campaign to save coal, the fuel Administration made special efforts to direct the attention of boiler owners to scale. I call attention to an article which appears in the issue of Dec. 10, 1918, of Power, entitled "Boiler Scale Prevention." This article contains tables showing the loss in efficiency due to scale and the coal wasted by scale. From this it appears that so thin a film of scale as 1/50th of an inch causes a loss in efficiency of 5.4 per cent, or, in terms of fuel, such a film of scale causes a loss of 100 pounds of coal for every ton burned. If the scale is as thick as 1/16th of an inch, the loss in efficiency rises to 12.4%, and the loss of coal rises to 200 pounds for every ton burned. This article urges upon engineers the very great importance of preventing the formation of scale in boilers on account of the loss in fuel.

The article in Power is offered in evidence marked "Plaintiff's Exhibit No. 9, Scale Prevention Article."

Another serious loss which is caused by scale is the necessity of shutting down the boilers in order to clean the scale out. In water tube boilers, this cleaning is done by special

tools, known as turbines, which are run through the tubes and cut out the scale, and in other boilers, by getting into the interior of them and chiselling the scale out. Of course, in order to accomplish such removal of scale, it is necessary to shut down the boiler and cool it off. After the scale is cleaned out the boiler must be refired. There is a great deal of loss of fuel due to this shutting down and refiring operation, and, in addition, the labor is costly. Finally, the surface of the boiler walls and tubes are more or less injured by the cleaning operation, if it is thoroughly performed, because it is impossible to scrape or chip off all the scale and not injure the boilers and tubes. In many cases a double boiler installation is necessary, one installation being used while the other is being cleaned of scale. Such an installation requires an investment of capital which is idle a considerable part of the time.

Another serious result of scale is explosions. When scale forms on the interior of the tubes, as I have pointed out, the heat does not pass rapidly away from the metal. The metal, therefore, becomes overheated, and blisters form on the tubes, this being technically known as "bagging." The metal in these bags or blisters is, of course, thin, because the metal is stretched out to form them, and these blisters break, resulting in explosions which may be accompanied by serious injury and loss of life. Even if there is no explosion where the boiler tubes break due to bagging, the boiler has to be shut down and the injured part renewed or repaired.

Another place in which scale gives a great deal of trouble is in condenser systems where water is used for cooling and condensing. As the water is heated cleaning of such condensers is exceedingly expensive and difficult because of their small tube construction.

All sorts of nostrums known as scale preventative or boiler compounds have been on the market for many years, but they are all inefficient and most of them valueless. The only way to prevent scale is to be sure that the water which is fed to the boilers or heating system is absolutely free from scale forming ingredients. Water which passes through a zeolite or base exchange silicate water softening apparatus has the scale forming ingredients absolutely removed therefrom.

Q. 27. Can you give any general idea of the possible savings in fuel which would be effected by the use in boilers of water of zero hardness?

A. Of course, my answer to your question must necessarily be somewhat speculative.

The Census of Manufacturers of 1914, page 545, gives the amount of coal used in the U. S. in the industries as approximately 180,000,000 tons, of which the greater part is burned in boiler plants for the production of steam. The tables given in the article on Boiler Scale Prevention show that with scale even as thin as 1/9th of an inch, the loss amounts to nearly 16%, if the scale is hard. If the scale is soft, the loss is about 15%. Of course, scale is frequently very much thicker than one-ninth of an inch. When the scale is thicker the loss is larger. If the average loss be fixed at say 11%, which is the loss due to scale one-sixteenth of an inch thick, and we assume that 2/3rds of the coal used is burned in boilers, the savings from the use of clean boilers would amount to over 13,000,000 tons, which at the present time would have a money value in the neighborhood of $65,000,000. This figure, if anything, is probably too low.

Plaintiff has so far installed (Mar., 1919) in power plants in this country 216 plants approximately, valued at about $830,000, not counting textile plants and laundry plants where the zero water is incidentally used for boiler feed purposes.

The particular importance in the laundry industry is the saving in soap to which I have heretofore generally referred. The experience of the Permutit Co. from its installation of its base exchange silicate water softening apparatus in laundries shows that the saving in soap amounts to from 40 to 60 per cent. of the amount of soap used with the hard water. Aside from the saving in soap, there are other advantages, such as the greatly improved character of the work. It is a common experience to pick up a towel in a hotel which has been freshly laundered but which is gray in appearance and which has a smell which may be described as rancid. The same is true of hotel sheets. This rancid smell and gray appearance are due to washing and re-washing in hard water.

Articles which are continually rewashed in hard water accumulate deposits of insoluble lime soaps to which I have referred which become almost imbedded in the fiber. This insoluble soap causes the rancid smell and gives the article the gray, unclean appearance to which I have referred. To avoid this accumulation of insoluble lime soap articles which must be continually laundered in hard water are sometimes subjected to strong acids which while they neutralize the lime soap tend to and do destroy the goods. In this connection I call attention to Special Bulletin No. 2, Vol. 5 of the North Dakota Agricultural Experiment Station, in which the writer of the article entitled The Case Against Hard Water points out that

a laundryman of Fargo, N. D., came to the station and complained that "his laundry work was turning out poor and that his consumption of soap had gone way up out of ordinary bounds". As the writer states, the Fargo City water softening plant—which is a precipitation plant—was at that time economizing in chemicals and the hardness of the water had gone from 125 parts per million up to 225 parts per million. The writer states this increase in hardness represented an increased soap consumption of about ten pounds for every thousand gallons of the water used for washing purposes and the laundryman as a result had his monthly soap bill increased $132. I call attention to page 25 of this Bulletin.

The "Bulletin" referred to by the witness is offered in evidence and marked "Plaintiff's Exhibit No. 10 Station Bulletin".

The Permutit Co. has some records which show the soap savings in laundries. I produce samples of these records which are in chart form. The first record produced is that of Excelsior Laundry, St. Louis, Mo. The hardness of the water used was 7 grains and the net savings shown are 52.86% in money. The next chart is that of the City Star Laundry of Harrisburg, Pa. The hardness of the water is 4½ grains, and the net savings in money amount to 41.80%. The next chart is that of Young Bros. laundry, at Ilion, N. Y. The hardness of the water is 30 grains, and the net savings in money is 69.45. The next chart is that of the Troy Laundry, at Canton, Ohio. The hardness of the water is 8 grains, and the net savings in money are 61.89%. The next chart produced is that of the North Shore Hand Laundry, at Chicago, Ill. The hardness of the water is 8 grains and the net savings in money amount to 48.38%. The next chart produced is that of the Crystal Laundry, at Cumberland, Md. The hardness of the water is 9 grains and the net savings are 56.03%. In all these charts the savings are net, that is, with the salt cost, the interest charge, and an allowance for depreciation deducted. The percentage saved is the saving on the investment in the Permutit plant.

The charts produced by the witness are offered in evidence and the same are marked "Plaintiff's Exhibit No. 11 Laundry Charts".

NEW YORK, March 4, 1919.

The Permutit Co. had installed up to March, 1919, about 112 plants in laundries. The value of these plants is about $400,000.

Canners have found that the use of zero water improves the quality of the food products. Vegetables, such as peas and beans when processed in zero water have a finer color, a better taste and are very much softer than when processed in hard water. I refer to an article by Dr. W. D. Bigelow, chief chemist of the Canners Association. This article appeared in No. 48, Vol. 41, of the "Canning Trade", which is the official publication of the Canners Association. The subject of this article is "Hard Water and Salt in Peas", and the writer in this article states the advantage of soft water in canning. The North Dakota Agricultural Experiment Station, in their Bulletin No. 2, Vol. 5, on page 26, state the following regarding the advantages of soft water in canning, this article being entitled "The Case Against Hard Water":

> "The precipitation of magnesia and lime salts from the water results in depositing this mineral matter on the surface of any vegetables, meat, cereal or the like, that may be boiled in the water. This coating of mineral on the food greatly impairs its flavor, darkens its color, and makes prolonged boiling necessary. In the case of tea and coffee it retards the extraction process. Bread has a lighter color, better flavor and rises better where soft water is used in making the dough. The writer is often asked to explain why this water or that will not cook beans, peas, and the like properly. The answer is, it is too hard. In one locality in this state, it is a common practice to test the water from all new wells by boiling up a batch of navy beans in it. If they soften properly and cook up well, the water is pronounced of good quality. If they remain firm and hard like so many stones then the correct assumption is that the water is very hard and generally unsuitable in quality."
>
> Plaintiff offers in evidence the July issue of the Canning Trade, particularly page 14 thereof, as "Plaintiff's Exhibit No. 12, Canning Trade Article."

The Permutit Co. up to Mar., 1919, had made about 574 domestic installations, that is, installations of zeolite water softening plants in private houses and hotels.

In the tanning industry the use of zero water has a great

many of the advantages mentioned above under the textile art. A better color and a better appearance of the leather results from the use of zero water in tanning. Furthermore, more tannin is extracted when zero water is used. In ice making zero water prevents the clogging up of stills and evaporator with the scale which would form when hard water is used. It thus avoids the loss of efficiency which results from the presence of such deposits and avoids the great expense and labor of cleaning such scale out of the stills and evaporators.

In the bright metal industry the use of zero water produces a very bright and uniform surface when zero water is employed in the pickling baths. I have an instance in mind where hard water was employed in the pickling baths of a cartridge shell factory. The hard water caused streaks and a non-uniform appearance in the surface of these shells which caused them to be rejected by the inspector. The installation of a Permutit plant and the use of zero water in these pickling baths completely solved this difficulty and from that time on the shells had a uniform and bright appearance.

The Cartright-Caps Co. specially has made use of the terms "water of zero hardness" and "velvet" even before they introduced zeolites, and when they were producing precipitation plants which do not approximate a water of zero hardness, and, as stated above, under the best circumstances, produce a water not softer than four or five grains in hardness. I produce an advertisement issued by the Cartright-Caps Co. of Chicago at the time they were only producing precipitation plants in which the terms "Soft Water Zero Hardness" and "Zero Hardness" occur. I further produce an advertisement issued by the Cartright-Caps Co. in which they use the term "The Original Zero Hardness People" and also "Zero Water".

Answer is objected to as incompetent and immaterial, and it is agreed that this same objection may stand for all questions along this line.

The first of these advertisements refers to precipitation plants exclusively, and not to zeolite.

The advertisement referred to by the witness is offered in evidence and marked "Plaintiff's Exhibit 13, Cartright-Caps Precipitation Plant Booklet".

The other advertisement referred to by the witness is offered in evidence and marked "Plaintiff's Exhibit 14, Cartright-Caps Borromite Booklet".

The exhibits are objected to as incompetent.

Subject to the objection noted, defendants' counsel admits that these exhibits were regularly issued by the Cartwright-Caps Co.

In operating the plaintiff's base exchange silicate or zeolite water softening apparatus, the element of cost consists practically entirely of the cost of the salt. The labor cost can be neglected, because it only requires a very short period of time on the part of an unskilled laborer to control the operation of a zeolite plant and usually one of the unskilled laborers around the customer's plant can spare enough time to attend to the Permutit plant, thus avoiding any additional charge for labor. This control consists in the dropping of salt in the salt tank for making up the salt solution, and the opening and closing of valves on the softener. The salt solution has to be made up once for every run of the softener which usually takes between 10 and 12 hours; and the valves are opened and closed only once during the run of the softener. In introducing its base exchange silicate or zeolite water softening apparatus, one of the difficulties which the Permutit Co. had to contend with was the extreme novelty and simplicity of its apparatus. The average concern purchasing such equipment and familiar with the water softening art expected large and complicated plants which required skilled operation to produce the result. Furthermore, in claiming that we produced a water of zero hardness, we aroused doubts and had to overcome incredulity because previous water softening plants had never produced such results. Again, we found that competitors, either out of ignorance or malice, prejudiced prospective purchasers' minds against our apparatus by stating that the reason the water from our plant makes a lather with so little soap is not that the water is of zero hardness but because the zeolite plant introduced some chemicals into the water and that it was a chemical trick. They furthermore claimed that our demonstrating outfit might produce results on a small laboratory scale, but that on a large commercial scale, we could not produce the results.

There was also great difficulty in explaining to the prospective purchaser how the zeolites automatically accomplished their exchange of their sodium for the calcium and magnesium of the water, and how automatically the reversal of the exchange takes place, by the simple passage of a solution of salt through the zeolites. This automatic and fool proof feature was very hard to make the purchaser believe. Furthermore, our competitors began to use the word "zero hardness" to describe

the water which they were producing from precipitation plants, and thus confused the customer and made it difficult for him to understand how our zero water was any better than the water produced by competitors with the old precipitation methods.

CROSS EXAMINATION BY MR. LOTZ:

I do not distinguish in any way between zeolites and base exchange silicates. "Base exchange silicates" is probably the more general term, but I employed both with the same general meaning. The base exchange reactions of both are essentially the same. I am not familiar with the base exchange reactions of silicates in the soil.

x-Q. 65. In speaking of the precipitation plant you have stated that a partial reduction of the hardness of the water results, but that zero hardness cannot be attained. Is it not a fact that for laundry use a water of a few degrees of hardness, say not to exceed four or five grains per U. S. gallon is amply good enough, because of the fact that practically all laundries employ some sodium carbonate in the water to help the soap action and saponify the free fats which find their way into the water, either from the soap or from the fabrics?

A. A water of a few grains of hardness cannot be compared with a water of zero hardness for laundry use, as evidenced by the fact that we have installed Permutit plants where the hardness of the raw water is only one and one-half grains, and we have also installed Permutit plants to finish the softening from existing lime-soda plants in laundries, and in both of these classes of instances, the effects of the use of zero water have been infinitely superior to the conditions existing before the installation of the Permutit plants.

x-Q. 66. Will not thorough filtration of hard water, the hardness of which is due to the presence of calcium carbonate effect softening of that water?

A. If the calcium carbonate is in solution, filtration through sand, which I understand the question to mean, will not change the hardness.

By calcium carbonate I mean mono-calcium carbonate.

x-Q. 68. You have stated in your direct examination that mono-calcium carbonate is insoluble, did you not?

A. Solubility is a matter of degree and time. It is not an absolute characteristic. The solubility of monocarbonate is negligible in comparison with the bi-carbonate, but it is the small solubility which causes the remaining four or five grains in the effluent from a lime-soda plant.

x-Q. 70. Isn't it rather the difficulty of solidifying the remaining four or five grains in water treated by the lime-soda process which causes it to remain in the effluent rather than its small solubility?

A. If a matter is soluble it does not solidify; it is only another expression for the same result.

x-Q. 71. A slightly soluble chemical, such as monocarbonate of calcium, is more readily solidified or precipitated by reaction with another chemical than a readily soluble substance like bi-carbonate of calcium, is it not, and if not, please explain why?

A. I don't know what is the relative tendency for precipitation of those two salts or compounds. My testimony regarding the lime-soda precipitation plant is based on personal experience.

I have recently operated two large lime soda plants for a period of a week each, conducting all the chemical tests and making all the chemical charges day and night. Both of these plants were in the state of Missouri, one at Rivermines, Mo., and the other at Deslouge, Mo., and the water was for boiler feed purposes.

The degree of hardness of the raw water was approximately between 20 and 30 grains.

There are many methods of determining hardness and one of the usual methods employed is the soap test, besides which there are gravi-metric methods in which the calcium and magnesium are precipitated and dried and weighed.

All of the points of description of the zeolite apparatus which I have given above are essential in the production of results. If any one of these points of description as necessary for a zeolite apparatus is not used, satisfactory results cannot be produced.

I did not state above anything about softening only. I refer to satisfactory results. An apparatus such as you describe consisting of a bucket with base exchange silicates dropped into it and water dropped into it may or may not soften the water, depending upon the composition of the water, the size of the bucket and the amount of the exchange silicate.

x-Q. 90. I hand you a copy of U. S. patent 632,091, the drawing of which seems to illustrate a sand filter. Will you please look at that patent and read as much of the description as you may deem necessary to understand the construction illustrated in the drawings and then state whether that filter illustrated and described in that patent would fall within the meaning of an ordinary sand filter?

A. Yes.

x-Q. 90. If the sand were removed from that filter and a base exchange silicate such as Permutit were substituted for the sand and water of say 10 grains per gallon hardness expressed in terms of calcium carbonate were passed through that filter and through the base exchange zeolites therein, would that water be softened?

A. It would depend upon the size of the filter and a number of things which I can't think of. I can't make a general answer.

x-Q. 91. Assuming a bed of base exchange silicates substituted for the sand four feet in diameter and three feet deep and water of the hardness stated in my previous question passed through that bed at the rate of 100 gallons per hour, for example, and assuming that the base exchange silicates were "permutit" which had been completely regenerated before its introduction into the filter, would that water be softened?

A. Assuming that there is nothing in the water to interfere with the action, a certain amount of zero water will be produced.

x-Q. 92. And then if salt water of the requisite strength were poured into the top of that filter and allowed to pass through the bed of "permutit" in it, and allowed to remain in contact with the "permutit" for the requisite length of time that "permutit" would be regenerated, would it not?

A. Referring to the picture in the illustration of the patent, there is no opening in the top of the filter through which such salt could be poured.

x-Q. 93. Let's assume that you had to take the top of the filter off to pour it in. On that assumption, by pouring the brine in from an ordinary bucket or barrel, or any other thing, would it regenerate the bed of permutit?

A. Assuming that the brine were perfectly pure sodium chloride and were used in the correct amount, and further, assuming that the apparatus in this picture was so altered that it would permit the salt to get in contact with the bed of zeolite there might be a partial regeneration accomplished.

x-Q. 94. Assume that the valves 21 and 24 are closed and likewise the valves 22, 28 and 29 and the cover 2 were removed, then if clear brine, such as you have described and of requisite strength were poured into the top of that filter casing, so as to completely fill the casing, and were allowed to remain for a requisite length of time, would regeneration of the Permutit in that filter be effected?

A. As I said before a partial regeneration would be effected. Regeneration may vary in its perfection and a certain method

and apparatus are required to obtain the most perfect regeneration. The method which you have described does not conduce to the best results but will effect a partial regeneration.

x-Q. 95. I have given you the dimensions or assumed dimensions of the bed of base exchange silicate or zeolite. Suppose that they were completely exhausted by reaction with hard water of a character adapted for softening by this Permutit, then how much brine of the requisite character and strength would be required to effect the complete regeneration of that bed of Permutit in a period of, say ten hours.

A. Assuming that the zeolite bed is four feet in diameter and three feet high, and assuming that the supply of raw water is shut off when the zeolites no longer deliver the zero water approximately four hundred gallons of brine will be required to regenerate the zeolite bed, of a strength of 5%, assuming that the zeolites are of the permutit type and the regeneration is downward.

x-Q. 96. And how long would that brine have to remain in contact with the zeolites, or, in other words, what period of time would be required for the flow of the 400 gallons through the zeolite bed?

A. The more time is given for the regeneration, the more thorough is the result. It varies anywhere from one hour up to 12 hours.

x-Q. 97. Will an average of six to seven hours be the proper time to get the best results?

A. The Permutit Co.'s average commercial practice is from six to eight hours.

x-Q. 98. You have limited your answer to the downward flow of the brine through the zeolites. What would be the difference in time if the flow of brine was upward instead of downward?

A. The upward flow would save salt and would give a more thorough regeneration, but the same applies as regards time to the upward as to the downward; that is, the more time allowed the better the result.

x-Q. 99. Why is the regeneration more thorough if the flow of the brine is upward than when it is downward, assuming the time to be the same in both instances?

A. When the regeneration is downward the salt solution is liable to find channels in the zeolite bed through which it will pass almost entirely and thus not come in proper contact with the remainder of the bed; with the upward regeneration this is avoided and the contact is thorough with every portion of the bed.

x-Q. 100. Is it a fact that where the regeneration by downward flow occupies from six to eight hours time, the entire bed of permutit is at all times submerged in the regeneration solution?

A. Not if there are channels present through which the brine may find a free passage.

x-Q. 101. In the example to which we have referred where the Permutit bed is four feet in diameter and the brine required is four hundred gallons, 5% solution, what is the commercial practice in the rate of flow of that brine through the zeolite bed?

A. An average of six to eight hours would give a general idea of the time required for the brine to pass through the zeolite. If you divide four hundred gallons by say seven hours, the rate of flow would be roughly sixty gallons per hour.

In the ordinary commercial practice of the Permutit Co. the first part of the brine introduced is allowed to run through the bed, but the brine drawn off is so located that the last part of the brine introduced stands in the bed and at about the level of the bed until it is rinsed out by the subsequent rinsing action.

x-Q. 104. Referring again to apparatus in which base exchange zeolites are used, such as you have testified to in cross-examination, with particular reference to a structure such as illustrated and described in the patent which I showed you, it is true, is it not, that the regeneration of the Permutit or zeolites is not in any way dependent upon the particular way in which the brine is introduced into the top of the filter?

A. I would say that it makes considerable difference how the brine is introduced. Control of the brine and distribution of the brine are affected by the manner in which the brine is introduced. The only essential thing in regeneration as well as in water softening by means of zeolites is to obtain proper contact between the zeolites and the liquid with which it is to react.

Marble has sometimes been used to remove free acids from the water before reaching the Permutit zeolite bed. Any suspended matter, such as mud, would interfere with the action of the zeolite filter bed. If the water contained amounts of mud or suspended matter, or any other suspended impurities, in time this mud would collect in the zeolite bed and tend to interfere with the softening action of the zeolite. Also if the water contains free acids, in time, the free acids may have an effect on the zeolite to interfere with their correct softening action.

x-Q. 110. In installing a permutit plant for softening water the area and depth of the zeolite bed or beds of the apparatus must be definitely proportioned to the volume and degree of hardness of the water to be softened and the length of continuous run without regeneration in order to produce zero water throughout a run of a given duration, that is true, is it not?

A. Yes.

x-Q. 111. And if the area and depth of the permutit bed should be too small, it would not produce zero water for the same length of time, would it, assuming, of course, that the rate of flow is the same?

A. If the amount of zeolites in the latter question is less than in the question immediately preceding then there would be less zero water produced by the smaller quantity of zeolites.

x-Q. 112. And in the lime and soda plants, the same general rule holds true, does it not, that is, if the quantity and strength of the chemical relied upon is reduced in proportion to the flow of hard water the effluent would not be the same in degree of softness as the strength or quantity of the chemical is reduced?

A. If the amount of chemicals is reduced below the proper amount in a precipitation plant, the water is under-treated, and the hardness is insufficiently removed. In the base exchange reaction between permutit and hard water the reaction is substantially instantaneous. The time that I have referred to required for the passage of the water through the zeolite bed is caused by the volume of the bed present as required by the hardness of the water and the volume of the water.

NEW YORK, March 5, 1919.

ARTHUR E. HOWLETT, a witness for plaintiff, testified:

My name is Arthur E. Howlett, I reside 536 W. 113th St., New York City, am 28 years, and a chemical engineer.

I was graduated in 1913 from the Massachusetts Institute of Technology with the degree of B.S. in Chemical Engineering. In 1914 I entered the employ of the Permutit Co. in the practice of my profession; in 1917 I resigned this position and went with John Johnson Co., Brooklyn, N. Y. as chemical engineer. I resigned to accept a commission in the Sanitary Corps of the U. S. Army. I have made investigations to determine the value of zero water in the textile arts, and conducted tests to determine with exactness the value of zero water in the textile arts. The most important and extensive were conducted at the plant of William F. Taubel, Riverside, N. J., in the latter

part of 1915. The Taubel concern has at Riverside, N. J., a large hosiery knitting mill. They have also several other mills in the east. At Riverside, N. J., they also have a dye works where the products of the different mills is sent for dyeing and bleaching. Their hosiery is manufactured of cotton, artificial silk and natural or gum silk. The raw water supply at the Taubel plant at Riverside, N. J., comes from several wells in the immediate vicinity. The hardness of this water varies be tween 33 to 75 parts per million, expressed as calcium carbonate.

The Taubel concern were having considerable difficulty in their color dyeing. It is the practice at this dye house to work exact shades, so that the product of their various mills will all be made uniform. They found, however, that with their practice it was not possible to get exactly the same shades of color on their hosiery on consecutive days. Also when hosiery was made of different fibers, the distribution of the color would not be perfect; that is, if a stocking was made of silk with a cotton top, heel and toe, the colors would penetrate the silk more or less than the cotton, with the result that the body of the stocking would not be the same color as the top. This necessitated considerable redyeing which is, of course, an expensive proposition, with a resulting loss in dye and labor. The capacity of the plant is also cut down.

This same difficulty was experienced whenever hosiery was made of two or more fibers, that is, with the combination of gum silk and cotton, artificial silk and cotton, or gum silk, artificial silk and cotton.

Before the redyeing, it was necessary to strip the dyes from the hosiery. By stripping I mean boiling off with water and salt, so that the dye is removed from the fiber.

I conducted a series of tests, to show if possible that by the use of zero water this difficulty in dyeing would be eliminated, and to determine exactly what the saving in soap would be. These tests were conducted by running two dye vats, holding approximately 70 gallons, in comparative tests. In one of these vats, the raw water was used as it had always been throughout the plant, and in the second vat, a water of zero hardness was used. The tests extended over a period of about six weeks.

The operations conducted were the preliminary washing and degumming of the hosiery by soap, and the subsequent dyeing of the washed fabrics. The washing was done first and the hosiery was removed from the vats. Rinsing was done in the same vats, and the dye solutions were also mixed in the

same vats. The purpose of the preliminary operations was to thoroughly clean the fibers to prepare them for the dyeing, and with the silk the degumming. The degumming of the silk is the removal from the silk fiber of the natural gum which is excreted by the silk worm on the fiber at the time of the making of the cocoon. This is removed from the fiber by hot soap solution.

These tests showed that 50% of the soap used in the raw water could be eliminated by the use of zero water.

The quality of the product washed and degummed in zero water was far superior to that degummed and washed in hard water. The silk had a much better luster, the feel of the silk was greatly improved and the silk crunch was better. The silk crunch is the sound of the silk when rubbed between the fingers. These tests also showed that when the silk degummed in zero water was subsequently dyed in dye prepared with zero water the product was superior. The dye penetrated the fiber better, the luster was better; and the color value was improved. We also found that when hosiery of different fibers was dyed in zero water the distribution of the color between, for example, the silk and cotton, was uniform, or equivalent. The fibers had the same color. This, of course, avoided a great amount of redyeing. When hard water was used, uneven colors resulted and the redyeing was necessary, which not only detracted from the visible qualities of the product, but was detrimental to the life of the silk. The color value of the hosiery dyed in zero water was so much better that the head dyer estimated it to be 25 to 35 per cent improved.

It was this estimation of the head dyer which led us to conduct tests using 20% less dye in the zero water than in the hard water. The results were very satisfactory and the quality of the hosiery dyed with less dye in the water of zero hardness was still superior to that dyed in the hard water using the full amount of dye. It was further shown that we could duplicate our results every day. With the zero water about 20% of the dyeing, or practically all of their redyeing, could be eliminated.

The net results of these tests were,

1. That up to 20% of the dye could be saved when using water of zero hardness; 2, a better product was obtained, the silk had a better luster and feel, and the color value was better; 3rd, 20% of their color work, or all of their redyeing, could be eliminated; 4th, 50% of the soap formerly used with the hard water for color work could be saved.

Tests were made in the black dyeing, also. The black dyeing was done in a different manner from the color work. The black dye is made up into what is called a standing bath. That is, a large amount of dye solution is made up, a part of which is used for each lot, and pumped back to the large supply. Only sufficient water and dye stuff is added to the standing bath to make up for that taken out by the hosiery. In the color work, a fresh solution is made up for each lot of material to be dyed. It was not expected that great reductions could be made in the amount of black dye with zero water with this method of dyeing. A standing bath, however, was made up containing 20% less dye stuff with water of zero hardness; that is, 20% less dye than would have been used with the hard water. The first test in the standing bath gave beautiful results, and it was not until the fourth lot that a slight decrease in the color value of the product was noted. Tests were here discontinued. The head dyer estimated from the result that 10% reduction in dye stuff would have carried the standing bath made of water of zero hardness equally as efficient as a hard dye bath made up with the full amount. It was subsequently found, however, in actual operation that 15% of the dye could be saved with water of zero hardness.

At the time these dyeing tests were being made, they were having considerable trouble in the bleaching of a certain quality of cotton goods. As the bleaching is done the cotton goods are boiled off with a caustic solution in large kiers. This solution contains caustic soda, sometimes soda ash and silicate of soda. After this boiling off these cotton goods are bleached. It was found, however, that with this quality of cotton goods the hosiery was stiff and harsh, so much so, that the men in the drying room where the hosiery is drawn into forms, complained that the goods were too stiff and hurt their fingers. The results from the boil off and bleach in water of zero hardness were entirely satisfactory. The product had a very fine color and was soft. It was also found that the time of bleach could be reduced from five to four hours, and that the chemical required could be reduced from 20 to 25%. As a result of these experiments a Permutit plant was installed at Taubel's Riverside plant. This has two filters, each softening 125,000 gallons a day, working alternately, one being regenerated while the other is softening water. It was necessary to erect a new building to accommodate the plant and the other auxiliaries. This plant has more than made good on the expectations from the preliminary tests which I conducted there. In soap saving alone it amounts to 400 pounds per day, which of the quality

they are using at Taubel, amounts to about $18,000 per year. They had previously used 1,000 lbs. per day, and this demand was reduced to practically 600 lbs. It is my estimate, generally speaking, that their savings are in the neighborhood of $75,000 per year due to the use of water of zero hardness.

In the woolen industry, the wool, which is full of natural grease and contains much dirt and sometimes even paint from the identifying marks on the sheep, must be thoroughly scoured or cleaned. This scouring operation, which is the technical name for thus washing the wool in the first instance, is done by boiling off with soap and soda ash. Wool scoured in zero water not only shows great savings in the amount of soap required to boil off the grease, but a superior quality of wool is produced. The wool has a better feel and a cleaner appearance. It is entirely free from grease and from the insoluble calcium and magnesium soaps which would be present if hard water were used which would interfere with the subsequent carding and dyeing operations. The wool scoured in zero water is springy when squeezed in the hand, and is more workable for the subsequent operations.

The wool dyer also realizes great benefit from the use of zero water. Before the wool comes to the dyer, it is moistened with oil, usually olive oil, to make it more workable in the spinning operation. The dyer must remove this oil before he can proceed with the dyeing operation and washing with soap is resorted to. When zero water is used in this washing, the oil is easily removed and the fibers become in the washing clean and soft. When hard water is used for this washing, the calcium and magnesium precipitate and the precipitate collects on the wool holding the fibers together and giving the wool a rather stiff feeling, and a more stringy appearance than where zero water is used. The advantages in the wool dyeing operations are about those which I have already described in connection with silk. Wool dyed in zero water has a much more lustrous and brilliant color value than when dyed in moderately hard water.

White wools come from the bleach in much better condition where zero water is used; there is less liability that they will subsequently turn yellow.

In the cotton industry there must also be an original cleaning and boiling off of the fiber which is done with soap, and the subsequent processes as to dyeing, etc., are similar to those I have already described in connection with silk. The results obtained by the use of water of zero hardness are substantially the same.

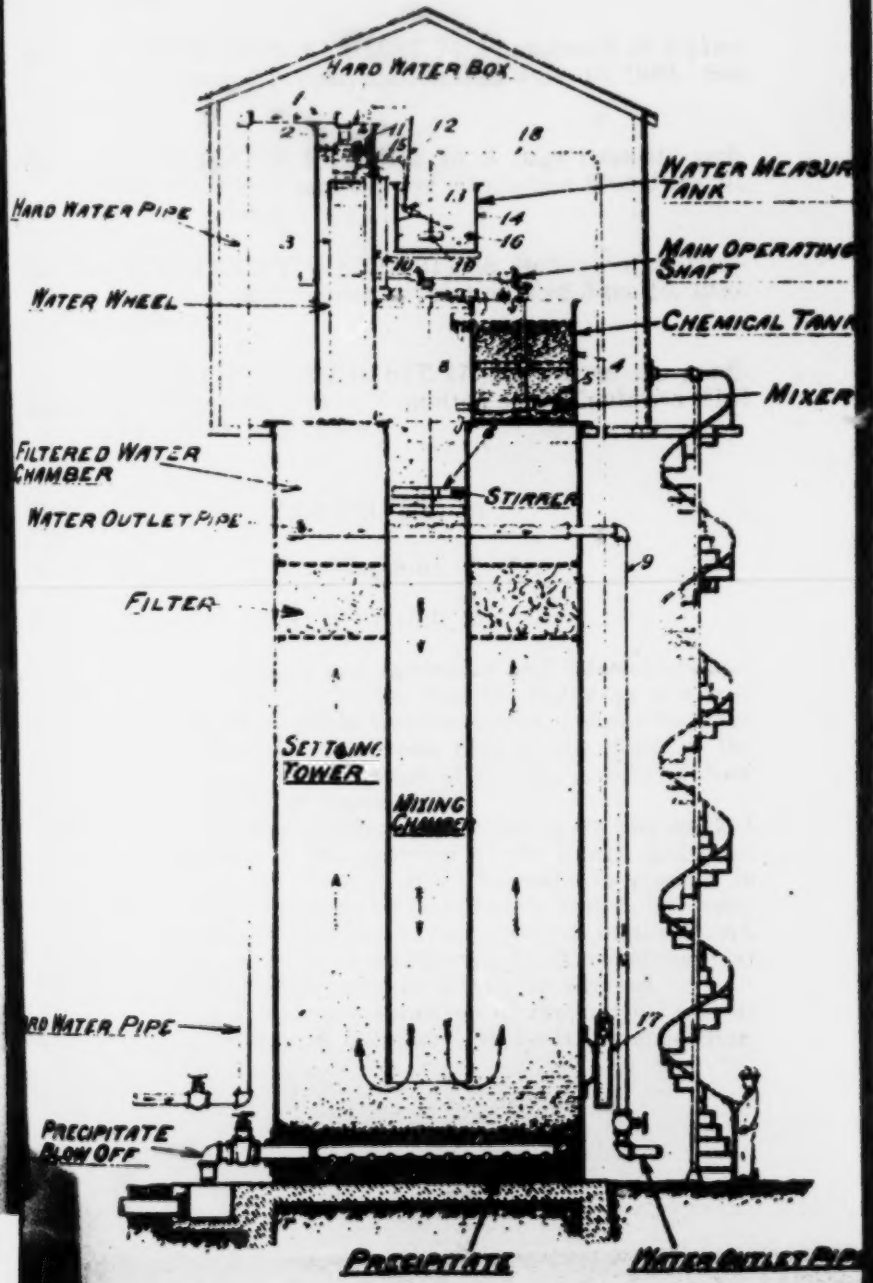
CROSS EXAMINATION:

The hardness of the water used in the Taubel plant varies between 33 to 75 parts per million. The equivalent in grains per U. S. gallon, is from two to four and one-half grains per U. S. gallon. I used a Permutit filter of a capacity of approximately 150 gallons per hour in my experiments at Taubel plant.

All of the advantages resulting from the use of zero water to which I alluded in direct examination are due to zero water *per se* entirely independently of the particular details of construction of the apparatus used to produce it.

PLAINTIFFS' EXHIBIT #12

TYPICAL PRECIPITATION PLANT



416-431 PLAINTIFF'S EXHIBIT 13, Bulletin of Agricultural Station, omitted per stipulation filed June 10, 1930. See index.)

432 (PLAINTIFF'S EXHIBIT 14, Photograph of a piece of scale, omitted per stipulation filed June 10, 1930. See index.)

433 (PLAINTIFF'S EXHIBIT 15, A page from the publication "Power," omitted per stipulation filed June 10, 1930. See index.)

434-449 (PLAINTIFF'S EXHIBIT 16, Bulletin of Agricultural Station, omitted per stipulation filed June 10, 1930. See index.)

450 (PLAINTIFF'S EXHIBIT 17, Page from the publication "Canning Trade," omitted per stipulation filed June 10, 1930. See index.)

451 PLFF'S. EX. 18.

* * (Caption) * *

STIPULATION.

It is hereby stipulated and agreed by and between counsel for the respective parties hereto that the following is a true and correct statement, subject to correction if error be made to appear, regarding certain tests held at the plant of the plaintiff company in the Borough of Brooklyn, City of New York on the 27th day of March, 1929.

This stipulation may be offered by either party and marked in evidence, subject to the approval of the Court, and shall stand, subject to correction if error be made to appear, in lieu of testimony regarding the facts herein stated, but nothing in this stipulation, subject to the approval of the Court, shall prevent either party from offering further testimony at the trial regarding these tests, as it may be advised.

Pursuant to notice, representatives of the parties met at the plant of the Permutit Company, 5401—1st Avenue, Bor-

ough of Brooklyn, City of New York, on Wednesday,
452 March 27, 1929 at about 11:15 A. M. The following persons were present:

On behalf of plaintiff:

Messrs. M. C. Massie, A. C. Bakewell, F. N. Waterman, E. W. Hammer, H. Kriegsheim, Eugene Staegemann, Eric Pick, William Lindsey.

On behalf of defendant:

Messrs. C. L. Byron, D. V. Moses, W. E. Titus, V. F. Lamela, R. Riley, J. G. Dye.

The device tested by the plaintiff in the presence of representatives of defendant was a water softener tank purchased by plaintiff from defendant, Graver Corporation on or about June 16, 1928, and for a description of this device as tested by plaintiff reference is made to paragraph 4 of a stipulation entered into by and between the parties on March 30, 1929 and to copies of three drawings attached hereto, namely Graver prints Nos. ZW-608 and ZW-338-A and Permutit print No. C-1941. Further reference is hereinafter made to these prints for fuller description of the device as tested. Paragraph 4 of the Stipulation above referred to reads as follows:

"4. That defendant, since the issuance of the Gans patent in suit, and within six years prior to the filing of the bill of complaint herein, manufactured and sold water softening apparatus identical with those disclosed and shown in each of Plaintiff's Exhibits 10, 11, 12, 13, 14, 16, 30 and 31, filed on the motion for a preliminary injunction herein; and, during the same period, made water softening apparatus, the same in principal as that purchased by plaintiff from the defendant on or about June 16, 1928, except the apparatus purchased by plaintiff was modified as requested in plaintiff's letter of June 8, 1928 to defendant, and as shown in defendant's drawings ZW-608, dated 6-22-28, and ZW-338-A, dated 3-1-27
453 which device was made especially for plaintiff and embodied the requested changes which consisted only of a manhole as indicated at "M" on said drawing ZW-608 and a welded-on flange with a 4 inch pipe opening provided with a threaded plug all as indicated at "N" on said same drawing."

The meter in the pipe leading to the softener gave a reading of 325,770 gallons at the beginning of the test; at the end

of the 25 minute run the same meter showed a reading of 327,200 gallons, indicating the use of 1430 gallons of raw water at the rate of 57.2 gallons per minute.

The raw water used had a chloride content expressed by the chloride radicle (Cl) of six parts per million (p.p.m.) and was Brooklyn city water (of about 2 grains per U. S. gallon in hardness) artificially hardened by the addition of calcium sulphate to the extent of 312 parts per million or 18.2 grains per U. S. gallon.

There were 50 cu. ft. of zeolite (green sand) in the tank. About 30 gallons of concentrated brine was used for regenerating the zeolites in this test. The hydrometer used for testing a sample of the brine showed about 98% of saturation. With the start of the test, brine was admitted at the top of the column of zeolites and passed downwardly through the zeolites. This injection of brine took about 2½ minutes, being followed with raw water rinsing downwardly through the tank. The following figures show the increase, the peak and the diminution of salinity at the outlet pipe. They also show the chloride content expressed by the chloride radicle (Cl) of samples of water taken from the test cock "O" in
454 pipe "P" of the tank at the beginning of the test and at each minute thereafter, for 25 minutes:

0 min.	6 p.p.m. Cl.
1 min.	10 p.p.m. Cl.
2 min.	180 p.p.m. Cl.
3 min.	3° Baume (18,000 p.p.m. Cl)
6 min.	6° Baume (36,000 p.p.m. Cl)
5 min.	7° Baume (42,000 p.p.m. Cl)
6 min.	6° Baume (36,000 p.p.m. Cl.)
7 min.	3° Baume (18,000 p.p.m. Cl)
8 min.	1° Baume (6,000 p.p.m. Cl)
9 min.	1900 p.p.m. Cl.
10 min.	1200 p.p.m. Cl.
11 min.	800 p.p.m. Cl.
12 min.	600 p.p.m. Cl.
13 min.	440 p.p.m. Cl.
14 min.	300 p.p.m. Cl.
15 min.	220 p.p.m. Cl.
16 min.	160 p.p.m. Cl.
17 min.	120 p.p.m. Cl.
18 min.	85 p.p.m. Cl.
19 min.	63 p.p.m. Cl.
20 min.	46 p.p.m. Cl.

21 min.	36 p.p.m. Cl.
22 min.	28 p.p.m. Cl.
23 min.	23 p.p.m. Cl.
24 min.	20 p.p.m. Cl.
25 min.	17 p.p.m. Cl.

In advance of the test the plaintiff had provided three test cocks in different portions of the Graver shell as follows:

Cock "A" in the side of the shell 1½ inches above the steel plate which is provided to support the gravel and zeolite beds;

A center cock "Q" in the middle of the curved bottom of the shell and projecting from the center of the flange "N";

A side cock "R" in the curved bottom just within the ring which is located between such bottom and the steel supporting plate for the beds; the recess formed by the flange is filled with paraffin as indicated at "U".

All as shown on plaintiff's blue-print C-1941 attached hereto.

455 After the softening test was completed, the plug of flange "N" at the bottom of the tank was removed and also the paraffin "U". In addition there was found within the tank at the bottom thereof just radially outwardly but lying against the notched ring, a long collapsed ribbon of paraffin crumpled into a twisted mass.

Samples of fluid were taken from cock "A" at the end of the 5th minute, 10th minute, 15th minute, 20th minute and 25th minute and the chlorides determined, with the following results:

5th min.	6° Baume (36,000 p.p.m. Cl)
10th min.	700 p.p.m. Cl.
15th min.	140 p.p.m. Cl.
20th min.	31 p.p.m. Cl.
25th min.	11 p.p.m. Cl.

It was estimated that the pipe leading from the bottom of the tank to the center cock outlet "Q" had a capacity of about 7 cu. centimeters. At the end of 25 min. a sample of 11 cu. centimeters was drawn off through this center cock "Q" (with a little additional spilled), representing the amount of brine which had been actually trapped in this outlet pipe to the center cock "Q". A test of this sample showed a chloride content expressed by the chloride radicle ('Cl') of 8,000 p.p.m.

Immediately after taking this little sample, a second sam-

ple of 375 cu. centimeters was taken and upon being tested was found to contain 28 p.p.m. of chloride content expressed by the chloride radicle ('Cl').

A third sample from the same center cock of 300 cu. centimeters of fluid showed a chloride content expressed by the chloride radicle ('Cl') of 16 p.p.m.

456 At the same time 11 cu. centimeters of fluid were drawn from the side cock "R", and this, on testing, was shown to have a chloride content expressed by the chloride radicle ('Cl') of 500 p.p.m. A second sample of 410 cu. centimeters from the side cock "R" showed a chloride content expressed by the chloride radicle ('Cl') 28 p.p.m., while a third sample of 300 cu. centimeters showed a cloride content of 16 p.p.m.

Allowing the tank to remain undisturbed for 15 minutes after the close of the 25 minute run, a test sample was drawn from each of the three taps showing the following chloride content expressed by the chloride radicle ('Cl'):

Center cock "Q"	16 p.p.m. Cl.
Side cock "R"	20 p.p.m. Cl.
Cock "A"	22 p.p.m. Cl.

After waiting another 15 minutes, additional samples were drawn from each of the three taps and, upon test were found to have the following chloride content expressed by the chloride radicle ('Cl'):

Center cock "Q"	27 p.p.m. Cl.
Side cock "R"	32 p.p.m. Cl.
Cock "A"	29 p.p.m. Cl.

After waiting a third 15 minutes (making a total of 45 minutes since the close of the downward rinse) additional samples were taken from the three taps showing the following chloride content expressed by the chloride radicle ('Cl'):

Center cock "Q"	52 p.p.m. Cl.
Side cock "R"	45 p.p.m. Cl.
Cock "A"	36 p.p.m. Cl.

457 After waiting still another fifteen minutes (making one hour interval since the close of the dawnward rinse) a test was made with an upflow through the tank, samples being withdrawn from the effluent (at test cock "S" in pipe "T") at the beginning of this test and at intervals of one minute for a period of 10 minutes. The meter reading at the start was 327,200 gallons and at the end of the 10 minutes,

327,940 showing the use of 740 gallons or 74 gallons per minute.

The chloride content expressed by the chloride radicle ('Cl') of the several samples were found upon tests, to be as follows:

0 min.	12 p.p.m. Cl.
1 min.	7 p.p.m. Cl.
2 min.	12 p.p.m. Cl.
3 min.	12 p.p.m. Cl.
4 min.	11 p.p.m. Cl.
5 min.	10 p.p.m. Cl.
6 min.	10 p.p.m. Cl.
7 min.	9 p.p.m. Cl.
8 min.	8 p.p.m. Cl.
9 min.	7 p.p.m. Cl.
10 min.	6 p.p.m. Cl.

Tests for softeness were made on certain of the drawn samples, taken during the test run by the use of standard B & B soap solution, the effect of the test being to determine when a substantial lather lasting a definite time, would be formed in 40 cu. centimeters of liquid upon the addition thereto of certain numbers of drops of the B & B soap solution. The result of these soap tests was as follows:

14th min. sample	8 drops B & B
16th min. sample	6 drops B & B
18th min. sample	5 drops B & B
20th min. sample	4 drops B & B
22nd min. sample	4 drops B & B
25th min. sample	3 drops B & B

458 It is to be noted that these tests were made by putting in two or three drops at a time, and then agitating the fluid with this soap solution and then successively adding one or two drops at a time until the desired lather was produced. It is also to be noted that by taking another portion of the 16th minute sample and adding 5 drops of B & B all at once, a satisfactory lather was produced; also, that with the use of 5 drops of B & B added at one time to a 15th minute sample there was likewise the production of a suitable lather.

A method of arriving at a determination of the amount of salt in a sample of fluid is as follows:

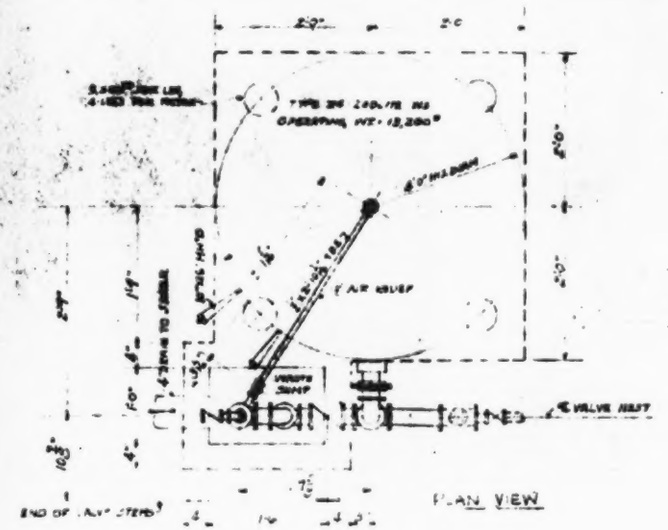
To calculate from the chloride content expressed in p.p.m. of chloride radicles, the weight of sodium chloride or common salt (NaCl) multiply by the factor 1.647 giving salt in

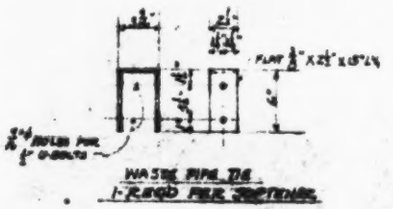
p.p.m. To reduce this to milligrams in the sample multiply by the number of cu. centimeters in the sample and divide by 1,000 cu. centimeters in a litre. To reducce milligrams to grains divide by the factor 64.8.

COOPER, KERR & DUNHAM,
Counsel for Plaintiff.

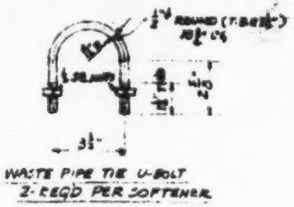
WILKINSON, HUXLEY, BYRON & KNIGHT,
Counsel for Defendant.

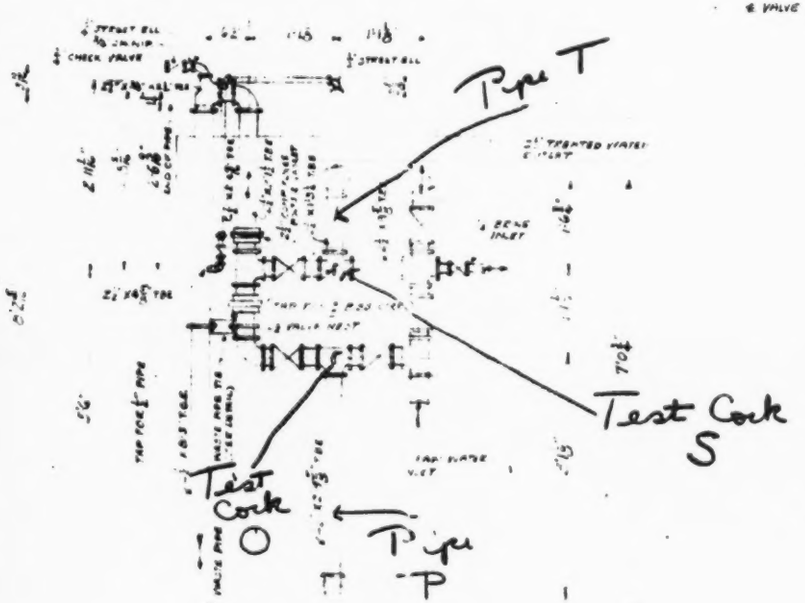
Dated: April 24, 1929.





NOTE -
VALVE NEST TO BE ASSEMBLED COMPLETE AT SHOP, TESTED & SHIPPED ASSEMBLED
ALL NIPPLES NOT NOTED AS TO LENGTH ARE STD SHORT NIPPLES





ERECTING	
DIVETING	
CAULKING	
TESTING	
PAINTING	

ORDER No.

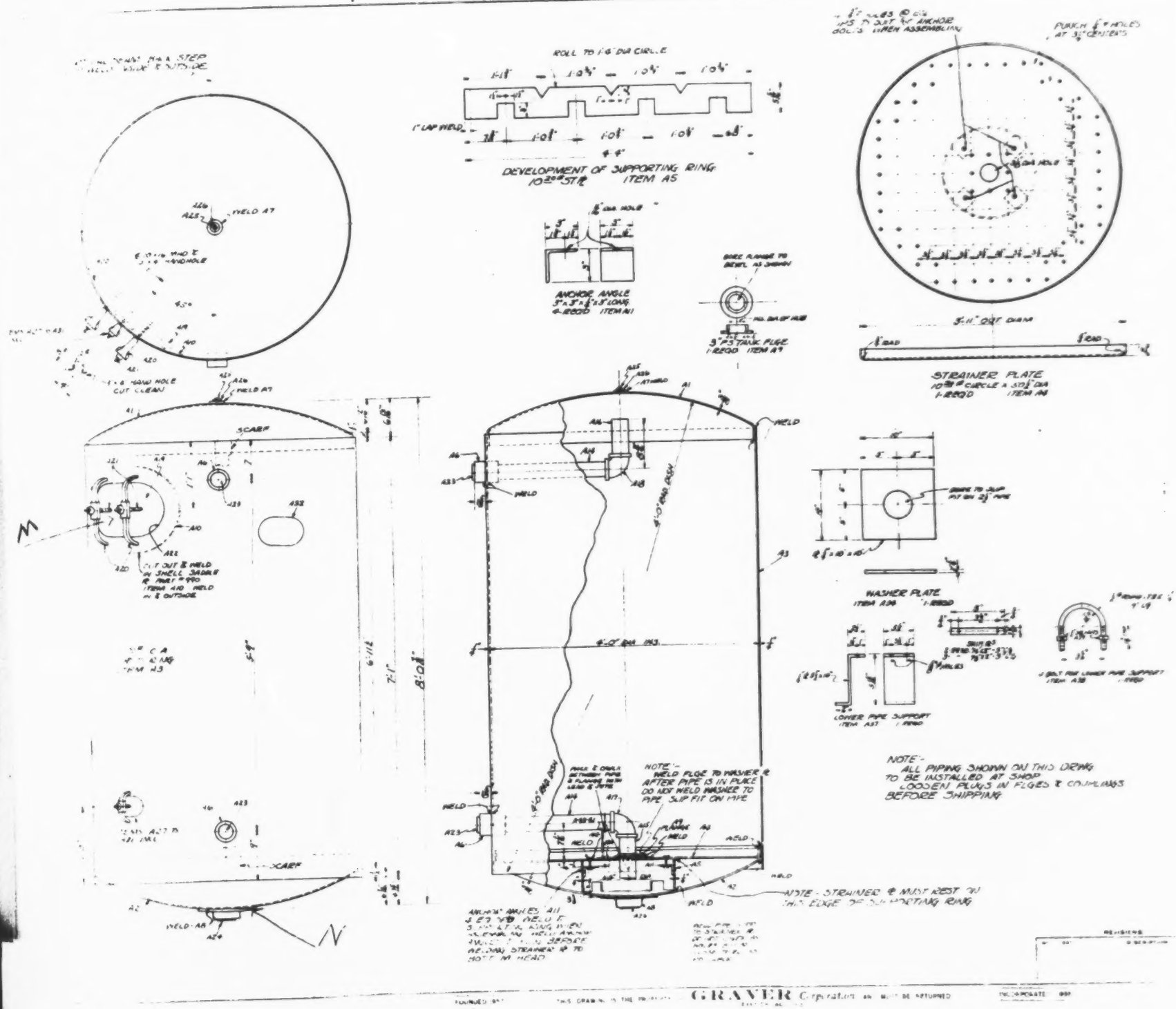
GRAVER Corporation
EAST CHICAGO, IND.

DRG No.

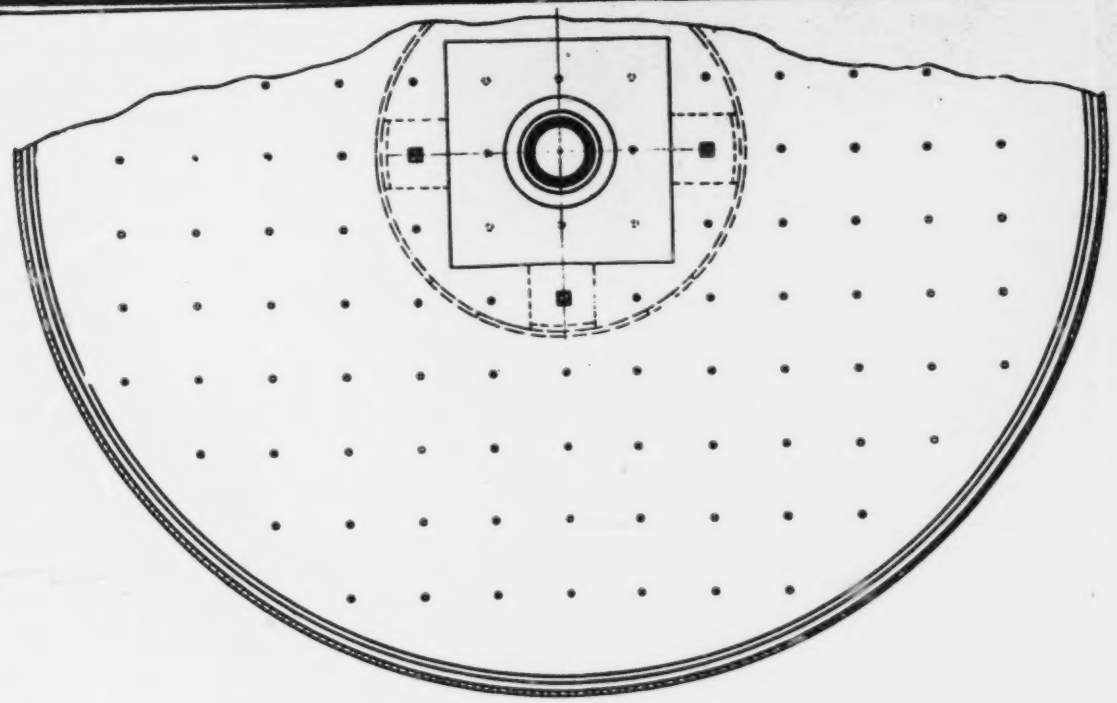
REVISIONS

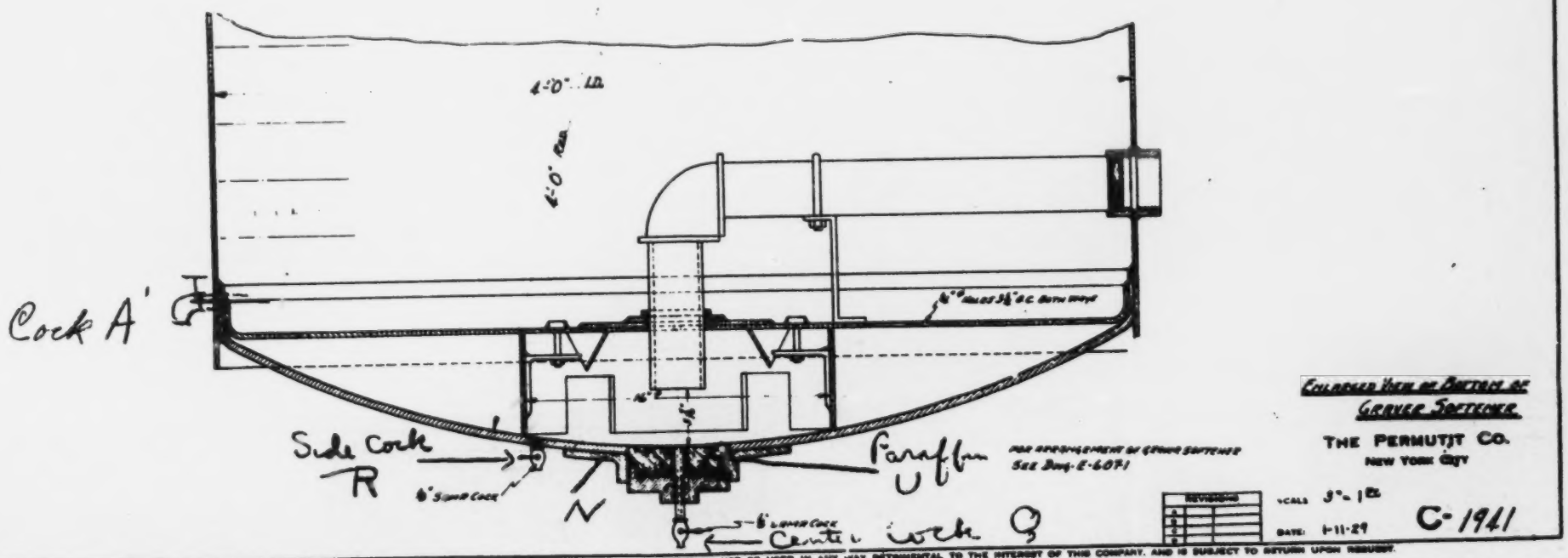
NO.	DATE	DESCRIPTION

FOUNDED 1887 THIS DRAWING IS THE PROPERTY OF GRAVER Corporation AND MUST BE RETURNED INCORPORATED 1904


ROLL TO 16'-0" DIA CIRCLE
DEVELOPMENT OF SUPPORTING RING
10 2nd STR ITEM A5
ANCHOR ANGLE
3"x3"x 5/16"x3'-3" LONG
4 REQD ITEM A11
3"#3 THICK FLGE
1 REQD ITEM A9
STRAINER PLATE
10 3rd CIRCLE x STD DIA
1 REQD ITEM A6
WASHER PLATE
ITEM A36 1 REQD
LOWER PIPE SUPPORT
ITEM A37 1 REQD
SCARF
CUT OUT & WELD
IN SHELL SAME
& PART # 990
ITEM A10 WELD
IN & OUTSIDE
NOTE:-
ALL PIPING SHOWN ON THIS DRWG
TO BE INSTALLED AT SHOP
LOOSEN PLUGS IN FLGES & COUPLINGS
BEFORE SHIPPING
NOTE:-
WELD FLGE TO WASHER &
AFTER PIPE IS IN PLACE
DO NOT WELD WASHER TO
PIPE. SLIP FIT ON PIPE
NOTE - STRAINER & MIST REST ON
THIS EDGE OF SUPPORTING RING
GRAVER Corporation

C-1941





Colonized View of Bottle of Grease Separator

THE PERMUTIT CO.
NEW YORK CITY

SCALE 3"=1'-0"
DATE 1-11-29

C-1941

THIS PLAN IS THE PROPERTY OF THE PERMUTIT COMPANY AND MUST NOT BE USED IN ANY WAY DETRIMENTAL TO THE INTEREST OF THIS COMPANY, AND IS SUBJECT TO RETURN UPON REQUEST.

462 (Endorsed) • • (Caption • • Stipulation. Cooper, Kerr & Dunham, Of Counsel for Plaintiff, 42 Broadway, New York City. Filed May 29 1930 at ..... o'clock .....M. Charles M. Bates, Clerk.

463 PLFF'S. EX. 20.

• • (Caption) • •

STIPULATION.

It Is Hereby Stipulated and Agreed by and between counsel for the respective parties hereto that the following is a full, true and correct statement regarding certain tests conducted by plaintiff at the plant of the plaintiff company in the Borough of Brooklyn, City of New York, on the 15th day of May, 1929.

The tests were run pursuant to notice heretofore given, and on the morning of May 15th Messrs. Cooper, Kerr & Dunham, of counsel for plaintiff, addressed and delivered a letter to Charles Byron, Esq., of counsel for defendant, to which Mr. Byron made partial response in a letter of the same date. Copies of these two letters are attached hereto. There were present:

On behalf of Plaintiff:

Messrs. H. Friegsheim, A. C. Bakewell, Erie Pick, F. N. Waterman, Eugene Staegemann, William Lindsey, E. W. Hammer.

On behalf of Defendant:

Messrs. C. L. Byron, D. V. Moses, R. Riley, J. C. Dye, V. F. Lamela, T. B. Clark, W. E. Titus.

464 The device tested by the plaintiff in this instance is the same as that tested heretofore on March 27, 1929, being the same apparatus referred to in paragraph 4 of a stipulation entered into by and between the parties on March 30, 1929, it being modified only in that there was substituted for the bottom valve used in the test of March 27, 1929, a new form of valve, as shown in the blue-print C-259 attached hereto and which did not embody any pocket or chamber leading to the valve proper within which a modicum of fluid would accumulate.

Before starting the test proper, sufficient raw water was passed upwardly through the Graver tank to reduce the zeolite bed to a state of hardness indicated by the fact that no lather would be formed in 40 C. C. of effluent upon the addition of 5 drops of standard B & B solution. This fact was determined by ascertaining that 15 to 17 drops of such B & B solution were required to secure a lather.

The raw water used had a chloride content expressed by the chloride radicle (Cl.) of 6 parts per million (p.p.m.) and was Brooklyn city water (of about 2 grains per U. S. gallon in hardness) artificially hardened by the addition of calcium sulphate to the extent of 460 parts per million (p. p. m.).

It is understood in this stipulation that where p. p. m. is used, parts per million are indicated, and further, that where the symbol Cl. is used the chloride content expressed by the chloride radicle Cl. is indicated.

The next procedure was the start of the regeneration of the zeolite bed through the induction of 31 gallons of brine of 25° Baume, this being determined by withdrawing 7 inches of brine from the brine tank. The concentrated brine was mixed with raw water through the ejector which conveyed the brine to the top of the Graver tank so that the ejector
465 brine or mixture had a degree of saturation indicated by 13° Baume.

After the brine had been passed into the Graver tank the water meter reading was taken and the downward rinsing started. The meter was also read at the end of the downward rinse and a comparison of the two readings indicated that a total of 765 gallons had passed through the meter during such rinsing operation. The time for down rinsing was 13 minutes 10 seconds which, according to the meter reading, meant a rate of flow of 58 gallons per minute.

Various tests of the chloride contents of the effluent, measured in p. p. m. Cl. were made and the down rinse was stopped at the end of 15 minutes 10 seconds at which time a sample of effluent was taken which showed 475 p. p. m. Cl., or somewhat less than the 500 to 600 p. p. m. which had been contemplated as the figure to be aimed at and which meant that slightly more rinsing had taken place than had been intended. It is agreed that had the rinsing operation been stopped with the chloride contents within the limits given above, the general character of the results secured would not have been altered.

Upon stopping the downward rinsing of the zeolite bed

there were two samples of about 3¾ gallons each drawn from the center of the curved bottom of the tank. The first of these two samples was tested and found to have 465 p. p. m. Cl. There were three tests also made of the second sample which showed an average of 455 p. p m. Cl. These two samples having stood for a time, were stirred or agitated and were again tested, the first sample then showing 470 p. p. m. Cl., and the second sample showed 465 p. p. m. Cl.

The next procedure was to upwardly rinse the zeolite bed. Samples were taken at one minute intervals for eleven minutes, or until a point was reached where soft water was 466 determined as being present by the application of 5 drops of B & B soap solution to 40 C. C. of effluent. The readings in p.p.m. Cl. of the eleven samples were as follows:

1st Min.	144 p.p.m. Cl.
2nd Min.	171 p.p.m. Cl.
3rd Min.	192 p.p.m. Cl.
4th Min.	190 p.p.m. Cl.
5th Min.	160 p.p.m. Cl.
6th Min.	134 p.p.m. Cl.
7th Min.	110 p.p.m. Cl.
8th Min.	88 p.p.m. Cl.
9th Min.	75 p.p.m. Cl.
10th Min.	64 p.p.m. Cl.
11th Min.	55 p.p.m. Cl.

The relative hardness of the water, as indicated by drops of B & B soap solution, beginning with the above samples for the 6th minute, was as follows:

6th Min.	15 drops
7th Min.	11 drops
8th Min.	8 drops
9th Min.	7 drops
10th Min.	4 drops
11th Min.	4 drops

This test was made by putting in B & B solution a few drops at a time. Thereafter a test was made on the sample drawn at the end of the 9th minute by putting in 5 drops all at once and a lather was secured; a similar test on the sample drawn at the end of the 8th minute and 5 drops did not produce a lather, the addition of two drops did not produce a lather, but the addition of two more drops (9 in all) did produce a lather.

The up-rinsing took eleven minutes and the meter indicated the passage of 641 gallons during that period, or an average of 58.3 gallons per minute.

After the test the Graver tank was emptied of its contents of zeolites and gravel beds. The several sizes or grades of gravel were found to be lying in their natural, distinct layers, sharply distinguishable.

467 After the Graver tank had been emptied of its contents of zeolites and gravel, an inspection was made of the interior, through the upper manhole and through the hole in the center of the curved bottom of the tank and it is agreed that the conditions found were normal.

COOPER, KERR & DUNHAM,
Of Counsel for Plaintiff.
WILKINSON, HUXLEY, BYRON & KNIGHT,
Of Counsel for Defendant.

Dated—June 28, 1929.

468 May 15, 1929.

Charles L. Byron, Esq.,
Wilkinson, Huxley, Byron & Knight,
First National Bank Building,
Chicago, Illinois.

Permutit v. Graver.

Dear Sir:

The test which we contemplate making today is to pursue the following course:

The zeolite bed is to be hardened to a point where five drops of B & B solution will no longer produce a lather in 40 cc. of effluent.

It is then proposed that 7 inches (31 gals.) of brine (saturated solution) be admitted.

The brine is to be immediately followed by a down flow rinsing at substantially 60 gallons per minute and the chlorides tested from the tenth minute onward until a point is reached where there will be a showing of 500-600 ppm. Cl.

The above point of 500-600 ppm. Cl. is selected in view of the statement by Mr. Moses, during the test made on March 27, 1929, that the Graver Company does not recommend extending the downward rinse to the point where the chlorides in the effluent substantially have disappeared as determined by chemical tests, but that the Graver Company recommends, as a commercial matter, that the downward rinsing be stopped

as soon as the salt taste practically disappears in the effluent. As this point is somewhat variable, due to the capacity of the individual to detect salt by taste, a figure of substantially 500 ppm. Cl. is taken as the approximate minimum amount detectable by taste; the test now to be made recognizes this and will stop at a point between 500 and 600 ppm. Cl.

469 When the down flow rinse is completed it is proposed to withdraw through the bottom valve in the tank two samples of fluid of 3¾ gallons each.

These two samples aggregate 7½ gallons, which is the calculated volume of the spherical segment space within the tank below the lower end of the central pipe.

There will then be an up flow rinsing with samples taken at one minute intervals until an effluent is secured which will give a lather upon the application of five drops of B & B soap solution to 44 cc. of effluent.

The above program for the test is submitted to you in advance in order to advise you of our understanding that the Graver Company instructs its users to continue the down wash, subsequent to regeneration, until the taste of salt in the effluent disappears and that such a point may be generally recognized as having a minimum value of about 500 ppm. Cl.; and with the idea that if this is not in accordance with your understanding, of such minimum value, you will instruct us of any criticism or objection on this point that you may have, in advance of the test.

When you inspect the apparatus to be tested you will see that the arrangement for taking samples from the bottom of the softener has been changed from that used at the former test of March 27, 1929 through the substitution of a new valve which avoids any collection of liquid in a passage-way to the sample cock previously used; a blue print, No. G-259, of the arrangement is attached. We also desire to assure

470 you that after the test has been completed the opportunity will be given you to remove the bottom valve shown on the enclosed blue print so that an inspection of the inside of the tank may be made from that point or through the upper man-hole if that is also desired.

Very truly yours,

dl

471 May 15, 1929.

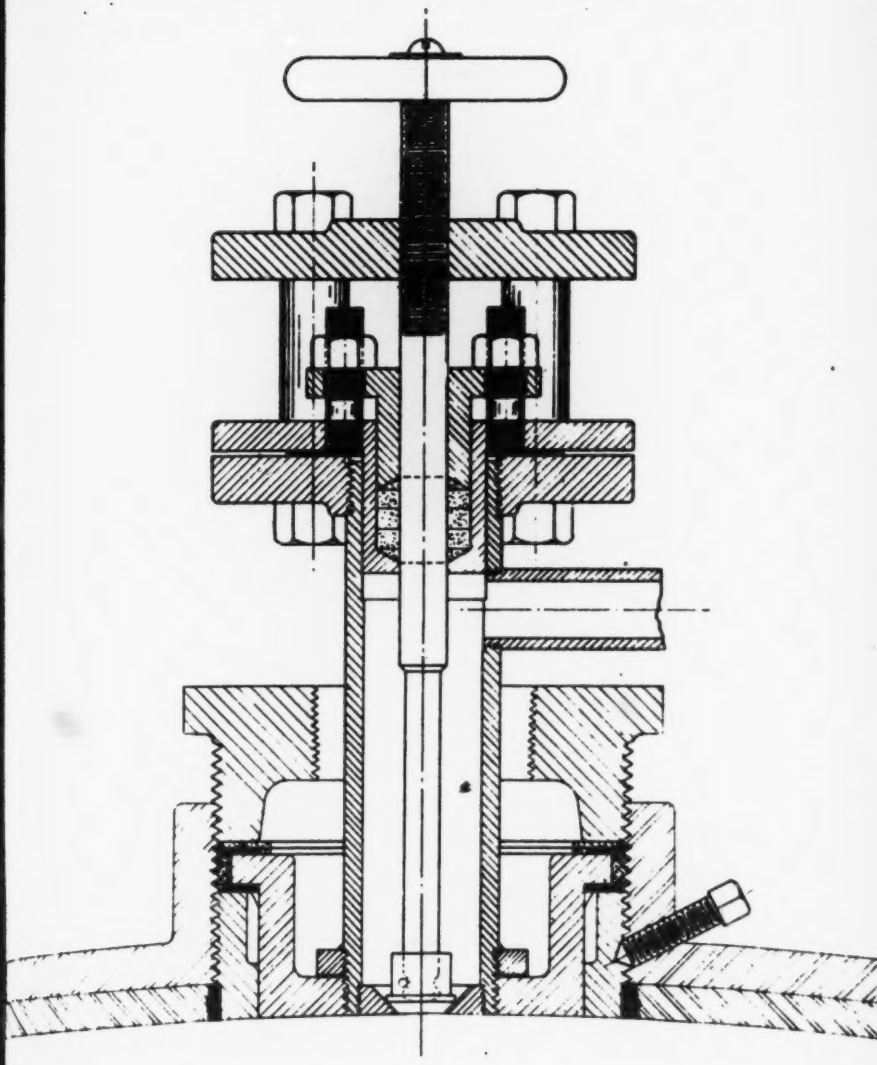
Cooper, Kerr & Dunham,
42 Broadway,
New York City.

Permutit v. Graver.

Gentlemen:

In partial response to your letter to me of May 15, 1929 am advised that the point at which the flow is reversed i the Graver softener is that at which the salt taste become faint. This is subject to some variations due to the com position of the effluent, the ability of the individual to dete salt by taste, and the fatigue of the state buds in the ind viduals tongue. Accordingly, the figure of 500 to 600 ppm referred in the last gapargraph, page one of your said lett may be inaccurate.

Very truly yours,
(sgd.) CHAS. L. BYRON

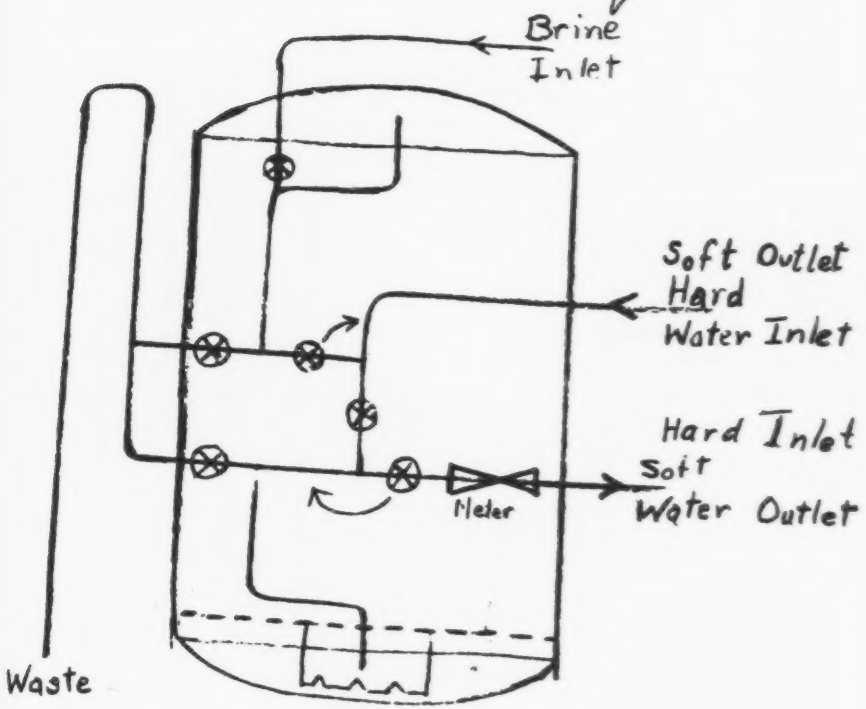


473 (Endorsed) * * (Caption) * * Stipulation. Cooper, Kerr & Dunham, Of Counsel for Plaintiff, 42 Broadway, New York City.

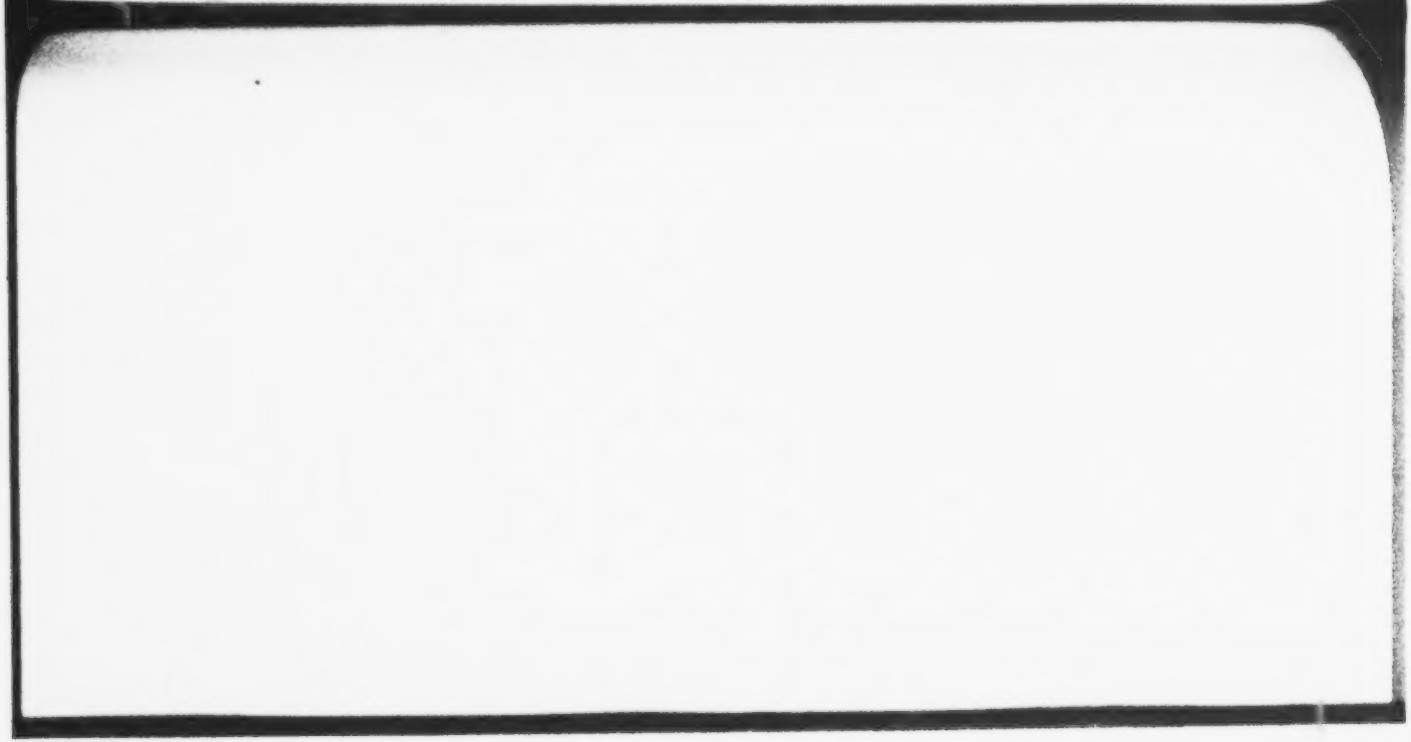
Filed May 29, 1930. Charles M. Bates Clerk.

Diffs for 2

(1)

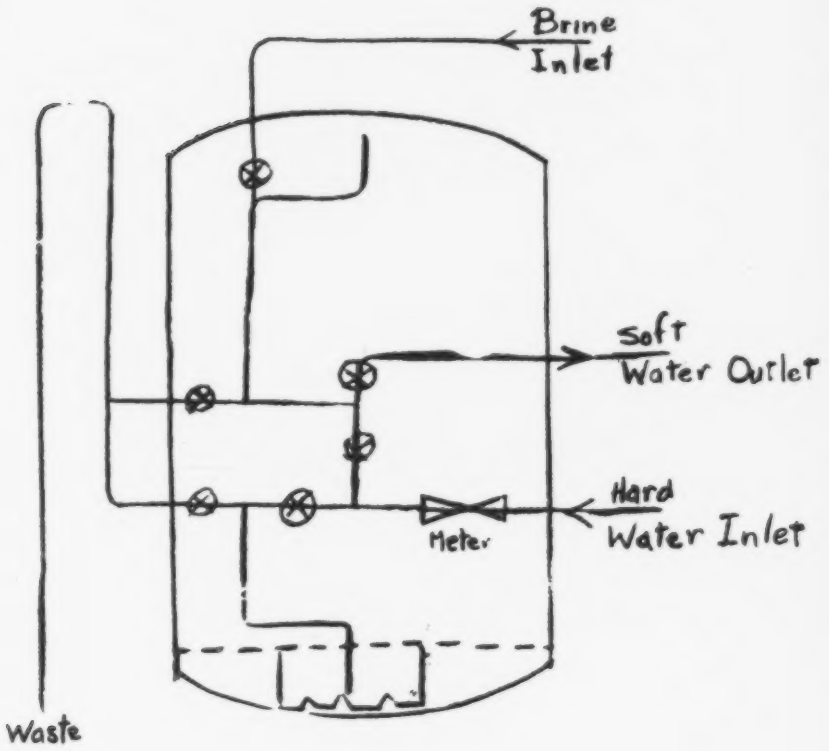


GRAVER '25 SOFTENER
DOWN FLOW



PLFFS. EX. D.

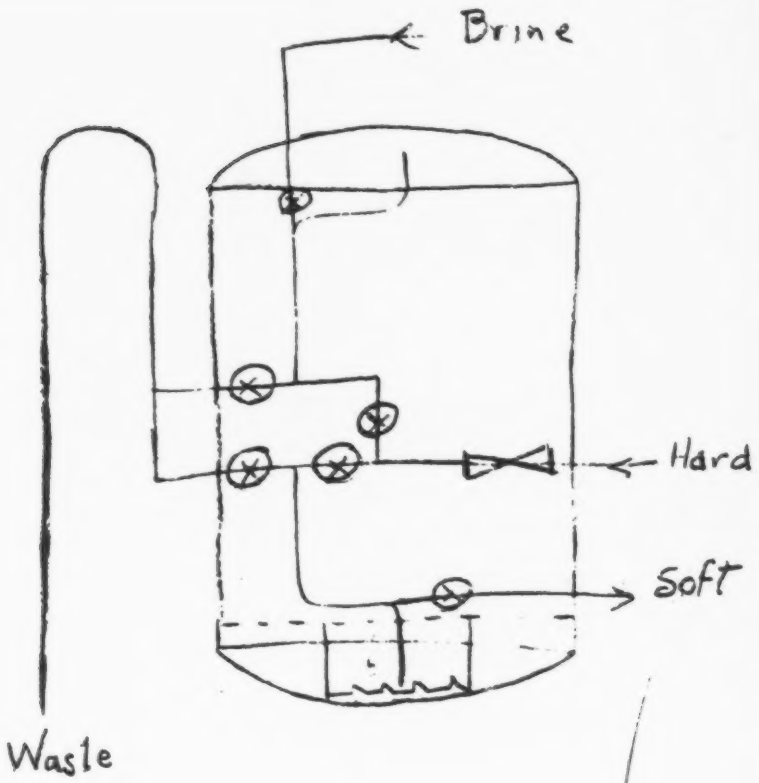
2



GRAVER '25
ARRANGED FOR
UPFLOW SOFTENING

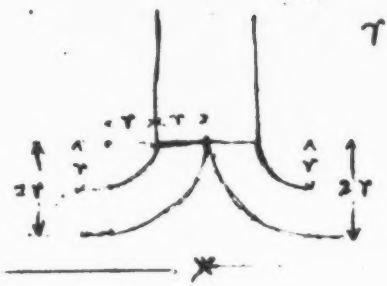
PLFFS. EX. E.

3



Graver '27 Upflow
Arranged for
Downflow Softening

77 And on to-wit: the 1st day of November, A. D. 1929, there was filed the following Exhibits, to-wit:



In the United States District Court,
Northern District of Illinois,
Eastern Division.

The Permutit Company,	:	
Plaintiff,	:	In Equity,
vs.	:	
Graver Corporation,	:	No. 7909.
Defendant.	:	

Plaintiff's Exhibit No. G.

PLAINTIFF'S EXHIBIT I.

In the United States District Court
Northern District of Illinois,
Eastern Division.

The Permutit Company, : In Equity.
Plaintiff,
vs.
Graver Corporation, : No. 7800.
Defendant.

Plaintiff's Exhibit No. I

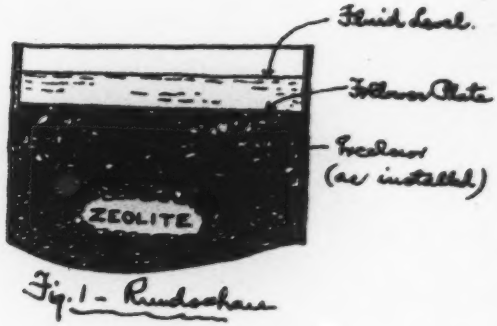


Fig. 1 - Rundsachen

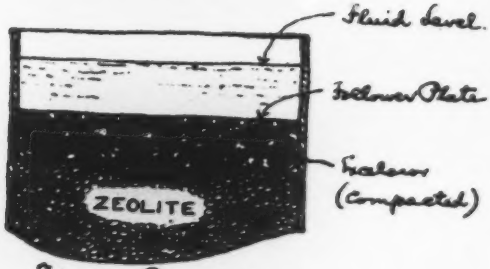


Fig. 2 - Rundsachen

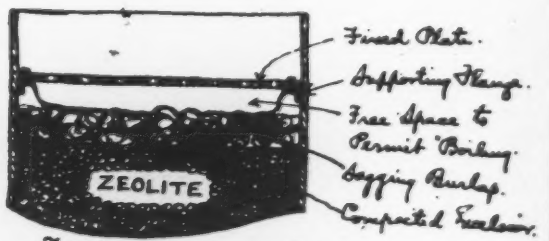


Fig. 3 - Hawthorne Berce

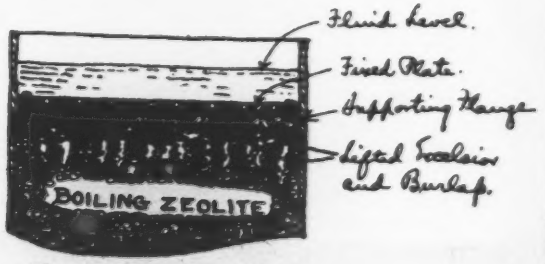


Fig. 4 - Hawthorne Berce.

PLAINTIFF'S EXHIBIT 1

480 And on to-wit: the 29th day of May, A. D. 1930, there was filed in the Clerk's office of said court certain Exhibits as follows, to-wit:

PLAINTIFF'S EXHIBIT "J".

Chicago, Apr. 26, 1920.

FRANCIS PAYNE MASON testified for defendants.

Direct Examination.

My name is Francis Payne Mason; age, forty-eight; residence, Winnetka, Illinois; profession, consulting chemist and chemical engineer.

I spent four years at the public schools in Basel, Switzerland, and then two years at the de Lycee de Marseille, France, and three years at the Institution of St. Cyr, France. Having made up my mind to pursue a general scientific education, I decided to enter the laboratory of Professor Fresenius at Weisbaden. I was three semesters as Student and private assistant to Professor Fresenius. I then proceeded to the University at Basel, Switzerland, and was a student there for three semesters; then to the University of Berne, Switzerland, where I was for four semesters and took my Doctor's degree. I was also private assistant of Professor Studer. I next took a postgraduate course at the Polytechnic at Carlsruhe under Professor Bunte, being his private assistant during this period. I then spent several months at Bochum in the Ruhr district in Germany making special investigations of the by-product coke industry, and particularly of the Otto Hoffman by-product coke ovens. Returning to the United States, I served six months with R. A. LeDoux & Company of New York as analytical and research chemist. I then accepted a position as chief chemist and chemical engineer of the United Coke and Gas Company of Philadelphia; I was three years with this company. I next came to the University of Chicago and did private research work there for one semester. Then I accepted the position of chief chemist and chemical engineer with the Pittsburgh Glass Company. I was with this corporation in this position for six years. In 1907 I returned to Chicago and opened an office as consulting chemist and chemical engineer.

During my connection with these various firms and laboratories it was my duty to make various water analyses and adapt filtration plants necessary for boiler feed water, such as for instance the one at Glassport, Pennsylvania, and vari-

ous boiler feed purification plants for the Pittsburgh Plate Glass Company in their different factories, of which at that time they had ten and were scattered all over the Middle West.

I have appeared before various courts, both abroad and in the United States. I have appeared in numerous patent cases as an expert.

Having obtained most of my education in the leading schools and universities of Europe, where all instruction was either in the French or German languages, and all my chemical and technical work in France, Germany and Switzerland being conducted in French and German, and since my return to the United States my practice having been practically entirely in the English language, I feel particularly well qualified to translate French and German and technical terms or scientific terms into their English equivalents.

I will state on the side that in 1911 I spent three months in Europe taking depositions in various countries in French and German, and the United States government specified that no translations of the depositions would be accepted unless made by myself; and I wish also to state that I was not on the side of the government, but represented the opposition in this case.

~~FRANCIS PAYNE MASON testifies for defendants.~~

Shown a photostat copy, marked Defendants' Exhibit, Gans Article of April 15, 1909, initialed A. W. N. P. (3 pages), and a typewritten statement (13 pages) entitled "Translation made by Dr. Francis P. Mason", and endorsed "Defendants' Exhibit, Gans Article of April 15, 1909", and initialed A. W., N. P. which was marked as above described by Augusta White, Notary Public, April 22, this is a translation made of the Gans article by myself in New York on April 22nd. This is a true, full and correct translation of the Gans article.

The photostat print and translation just identified by the witness are offered in evidence, and marked "Defendants' Exhibit, Gans Article of 1909."

Examining this Defendants' Exhibit, Gans Article of 1909, the direction of softening water is not directly stated as such. It is implied by the description of the apparatus and arrangement of the two filter beds and the Permutit bed to be downwardly.

It is distinctly stated that during the process of regeneration the warm salt solution is poured upon the upper surface of the filter, and therefore regeneration takes place downwardly.

The direction of the wash water flow is not specifically stated, but it is implied to be upwardly because the writer states that the purpose of the upper sand filter is to prevent the mechanical washing away of fine particles of Permutit.

Referring particularly to that part of this article on the right hand column of page 199, beginning with the fifth full paragraph, beginning with line 29, a complete technical English translation of this statement has already been made and is in evidence in the exhibit handed me, and is as follows:

"The permutit bed lies upon fine sand, which becomes coarser at the bottom. At the top it is best closed off by a sand filter placed about one-third to one-half meter above the surface of the Permutit layer. The sand filter under many conditions can be replaced by a limestone filter, for instance, when treating water containing iron and acids. This arrangement of the upper sand or limestone filter will also prevent that by back washings, the specifically lighter Permutits are not mechanically washed away."

To avoid any possibility of error in translating this paragraph, I have made a word-for-word translation, giving the German word on one line and underneath it the English word which I read.

Die	Permutitschicht	lagert	auf	einem,	nach	der	Tiefe	zu	groeber	werdendem	
The	Permutit layer	lies	on	one,	towards	the	bottom	to	coarser	becoming	
Sande,	Nach	oben	hin	wird	sie	am	besten	von	einem	Sandfilter	abgeschlossen,
sand.	Toward	the	top	is	she	best		by	a	sandfilter	closed off,
das	in	zirka	½	bis	½	m	Höhe	über	die	Oberflaeche	der	Permutitschicht
that	at	about	½	to	½	m	height elevation altitude	above	the	surface	of the	Permutit layer
angebracht	ist.										
placed	is.										
Das	Sandfilter	wird	unter	manchen	Umstaenden	besser	durch	ein	Kalkstein		
The	sandfilter	is	under	many	conditions	better	by	a	limestone		
filter	ersetzt,	z. B.	bei	eisenhaltigen	und	sauren	waessern.				
filter	substituted	for example	with	iron-containing	and	acid	waters.				
Diese	Anordung	des	oberen	Sand-	oder	Kalkstein	filters	soll	weiter		
This	arrangement	of	the	upper	sand	or	limestone	filter	shall	further	
verhindern,	das	bei	Rückspülungen	die	spezifisch	leichten	Permutite				
prevent,	that	by	backwashings	the	specifically	light	permutites				
mechanisch	abgeschlaemmt	werden.									
mechanically	washed away	are.									

My attention is called to an affidavit by Alfred Mueller, in which affidavit he says:

> "I do not agree with Dr. Mason's translation of this part of this article, and I think he has failed to understand the meaning of the language used. I translate this part of the article as follows:
>
> "'The layer of Permutit rests upon fine sand, becoming coarser towards the bottom. At the top it is best terminated by a sand filter having a height of about ⅓ to ½ meter, which is arranged above the surface of the layer of Permutit. The sand filter is, under certain circumstances, better replaced by a limestone filter, *e. g.*, in connection with iron-containing and acid waters. These arrangements of the upper sand—or lime—stone

filter shall moreover prevent that at back-washes the specifically light Permutits are mechanically flushed away.'"

I do not agree with this translation by Alfred Mueller, and find in the original German text no warranty whatever for it, where it states "At the top it is best terminated by a sand filter having a height of about one-third to one-half meter, which is arranged above the surface of the layer of Permutit." The German text distinctly says that the sand filter is placed or secured at a height of about one-third to one-half meter above the surface of the Permutit. There are one or two other words which I disagree with. For instance, the translation of the word "abgeschlossen" being given as "terminate". The proper translation is "closed off".

Referring to an affidavit May 15, 1922, by Alexander Green, in which affidavit he says:

"It is best that on its upper surface it be bounded by a sand filter which is placed over said upper surface of the layer of Permutit in a depth of from one-third to one-half meter."

The same mistake in translating has been made by Mr. Green as by Mr. Mueller in that he attributes a depth of from one-third to one-half meter to the sand, whereas these distances refer to the elevation of the sand filter above the upper surface of the layer of Permutit.

Seeing that the writer is a doctor and heads the article by "Dr. R. Gans" and that the title of "Dr." is not lightly conferred in Germany, I think it can be safely assumed that if Dr. Gans had intended to locate the sand filter immediately on top of the Permutit layer, he would have used these words: Auf die oberflache der Permutitschicht liegt ein sandfilter von circa ein ⅓ bis ½ m Höhe, oder dicke."

CHICAGO, May 26, 1922.

The qualifications necessary to obtain in Germany the degree of Doctor, are a satisfactory completion of the primary and secondary common school grades; a diploma from a high school, either a Real Schule or Gymnasium. This entitled the successful candidate to admission to a university. At the university he picks out the particular faculty in which he wishes

to take his degree. The course of studies is entirely by lectures. At the end of a proper period of instruction, the candidate applies to the faculty for a thesis, which is given him. On this thesis he works anywhere from two to as much as four years. The thesis is submitted to the faculty and upon being accepted as adequate the candidate is now eligible for examination. The examinations consist of three days, written examination in the various branches the student has been studying, and one whole day of oral examination. The candidate being examined for one whole hour alone in a room by the professor whose lectures he has followed. The examination is immediately reported to the faculty and the candidate informed as to whether he has passed or not. In case of failure, he may repeat the attempt one-half year later, and not before.

In the Swiss and German University that I attended the examination is conducted in the German language. I have a doctor's degree given me by the University of Berne, Switzerland, in 1895.

Having myself received all of my primary, secondary and university training in the German language, being constantly associated with German teachers, doctors, professors and scientific men, and being able through this training to place myself mentally in their class, I cannot understand how any difference in language or method of thought could be used in expressing the statement which I have translated.

I am constantly using, reading and writing the German language. In fact, it has become so much a part and parcel of myself that to this day I do the multiplication table and all of my chemical work in the German language. I am a member of several German societies and served in the United States Secret Service during the war in the capacity of interpreter and interviewer of Germans.

My family is among the oldest in the United States, having landed here in 1649. I was born in Cleveland, Ohio, which originally was founded by one of my ancestors.

Respecting the affidavit of Alfred Mueller, criticizing my translation of the Gans article, in which he says:

> "The word 'abgeschlossen', taken in connection with the words 'nach oben hin', clearly means that the sandfilter is resting on a surface of the Permutit layer. I note that Dr. Mason has failed to translate the word 'Höhe', which clearly indicates that the dimensions 'das in zirka ⅓ bis ½ m Höhe uber der Oberfläche der Permutitschicht' applies to the depth of the sandfilter placed above the surface

of the Permutit. In the German language, the idea of thickness or depth of a layer of material or liquid is always expressed or described by the measurement from the bottom to the top and is called, literally speaking, the height of the layer, that is, the word 'Höhe' is used to describe it",

Mr. Mueller has entirely missed the intention and wording of the writer. The word "abgeschlossen" means "closed off", and applies in this sentence to the Permutit layer. What closes off is described to be a sand filter which is placed at about a distance of one-third to one-half meter height above the layer of Permutit. The statement made by Dr. Gans is so clear that I cannot understand how it can be tortured into any other meaning by anyone who pretends to be familiar with the German and English languages.

In my translation I used the following words: "At the top it is best closed off by a sand filter placed about one-third to one-half meter above the surface of the Permutit layer." The measurements one-third to one-half meter mean, if one wishes to add an extra word, "height above the surface of the Permutit layer." In my opinion, in the English language, the addition of the word "height" in so plain a sentence is unnecessary and is amply expressed by the simple word "above."

Referring particularly to that part of Mr. Mueller's comment which reads: "In the German language the idea of thickness or depth of a layer of material or liquid is always expressed or described by the measurement from the bottom to the top and is called, literally speaking, the height of the layer, that is, the word 'Höhe' is used to describe it." I would say that in German the thickness of a layer or a man or a sheet of paper is very commonly called "die dicke." I think that Mr. Mueller is in error in stating that these dimensions are always called "die Höhe." Where the idea of height above a thing is implied, for instance, the height of an hotel above sea level in the Swiss mountain resorts, the sentence would be: "Die Höhe über die oberflaeche das Meeres", meaning the height above sea level.

I have at hand G. J. Adler's dictionary of the German and English languages, where "dicke" is given as "thickness."

Referring to the statement of Mr. Mueller in his affidavit:

"I note that in the paragraph preceding the one I have been discussing, in which Dr. Gans refers to the depth of the Permutit bed, he uses the words "die Höhe der Per-

mutitschicht richtet sich', etc., and the word 'Höhe' is evidently used in the same sense in both paragraphs."

I say that the first use of the words "die Höhe" applies to the height or thickness of the Permutit layer, whereas the second use applies to the height of the sand filter above the surface of the Permutit layer. Therefore, the meaning is entirely different.

Referring to Mr. Mueller's statement:

"* * * In my opinion, had the author of this article been intending to describe a sand filter which was located at a distance above the layer of Permutit * * * he would have used, instead of 'Höhe', the word 'abstand'."

I say that Mr. Mueller's opinion is volunteered and finds no basis whatever in Dr. Gans' statement.

Asked whether "abstand" would be a word as good as "Hohe" if the meaning intended by Dr. Gans were as I have translated it, or whether other changes in the sentence would be involved to make it good German such as a Doctor would use, I reply "abstand" can be literally translated as the difference of space between two points; that is, two entities stand at a certain distance apart from each other. The exchange of the word "abstand" for "Höhe" in this particular sentence does not add to the clarity of Dr. Gans' statement since he very clearly says that the sand filter is located at a point about a third to a half a meter above the Permutit layer. In other words, the two terms in the sentence could be used synonymously if so wished, perhaps; but Dr. Gans preferred to use "Höhe" instead of "abstand."

Referring to the statement in Bernard R. Regen's affidavit:

"This word 'Höhe', in connection with the rest of the sentence, makes it clear that the depth or thickness of the sand filter is referred to and not the distance that the sand filter is placed above the Permutit layer, as Dr. Mason's translation indicates by omitting the translation of the word 'Höhe.' Any interpretation of the words above referred to to indicate that the sand filter is located at a distance above the Permutit layer is negatived by the words 'nach oben hin' * * * abgeschlossen."

I say that it is a complete distortion of the meaning of Dr. Gans' description, and I do not understand how, in spite of the clear language of the rest of the sentence which describes the sand filter as being placed at a distance of about one-third to

one-half meters above the surface of the Permutit layer, Mr. Regen now moves it down on top of it. It is the obvious intent of Dr. Gans to state that the top of the whole apparatus which he describes in the previous paragraph and this paragraph, is closed off by a separate, independent sand filter, which he further states in some cases can be advantageously replaced by a limestone filter.

I have read the affidavits of Alfred Mueller, Alexander Green, Bernard R. Regen, C. V. Bertsche, Frank N. Waterman and Heinrich Kriegsheim, and have carefully considered all the criticisms in these affidavits of my translation of the Gans article, together with the translations offered by those affiants and their deductions therefrom, but I have not changed my mind as to the correctness of the translation offered by me.

I have heretofore testified concerning various forms of apparatus used in connection with the zeolites or base exchange silicates, and in my opinion, this article is a description of the Gans apparatus patent in suit, for the following reasons: We have, first, an iron or wooden filter, at the top of which is a sand filter, or sometimes a limestone filter; then comes an open space described in the Gans article as being about a third to a half a meter in distance, until the upper surface of the Permutit layer is reached; a Permutit layer resting upon fine and then coarse gravel; which is substantially the construction of the patent in suit.

Cross examination omitted by agreement.

Mr. Knight: I believe the record should show that none of the counsel in this case were present at Buffalo at the trial of the case against the Refinite Company and others, to which Mr. Massie referred in his cross examination of this witness. Also, that when this witness was testifying at Buffalo, he was not a witness for the defendant in this case as that was an independent litigation, and also that the article by Dr. Siedler, which Mr. Massie referred to in his cross examination of this witness, is not in evidence in this case, nor a translation of it. The fact is that this Gans article of April 15, 1909, came to the notice of the defendant in this case through a search made upon my order by our regular foreign patent agent, Marks & Clerk. My entry of appearance in this case was made February 21, 1922, and this article reached me, as nearly as I remember, on the 18th or 19th of April, 1922, from Marks & Clerk.

ADOLPH CARL NOÉ testifies for defendant.

DIRECT EXAMINATION:

My name is Adolph Carl Noé; age, forty-eight; residence, 5717 Kenwood Avenue, Chicago, Illinois; occupation, professor in the University of Chicago.

I was professor of German and am teaching now Peleobotany and scientific German.

I was born in Graz, Austria.

I was educated in the universities of Graz, in Austria, of Goettingen in Germany, and then the University of Chicago. I have a bachelor's degree and doctor's degree.

I was appointed professor in the University of Chicago in 1903, nineteen years ago.

I taught in the University of Graz in Austria and Leland Stanford University in California.

I am one of the abstractors for the publication known as Chemical Abstracts.

Referring to a photostat copy of a German publication marked Defendants' Exhibit, Gans Article of April 15, 1909, I have read this article and translated it into English.

Turning to the right hand column of page 199 of this article, I translate into English the two paragraphs, the first of which begins on line 21 as follows:

The apparatus consists of an iron or wooden filter. The height of the Permutit layer depends upon the degree of hardness of the respective waters and of the filtration speed. The useful effect is so much greater the slower the water flows through the Permutit filter and the finer the grain of the Permutit is.

The Permutit layer lies upon fine sand which is getting coarser towards the bottom. Above it is best closed by a sand filter which is placed at a height of about from one-third to one-half meter above the surface of the Permutit layer. The sand filter is under some circumstances better replaced by a limestone filter. For instance, in case of iron-containing and aciduous waters. This arrangement of the upper sand or limestone filter should, furthermore, prevent that in case of back washing the specifically lighter Permutit should be mechanically carried away.

Mr. Knight: I ask that the record show that in answering the last question the witness had nothing before him but the German text from which he was translating.

I do not know anything about this case for which I am testifying, nor do I know for whom or against whom I am testifying.

I have never met Dr. Mason before I was introduced to him a few minutes ago.

I have not seen any translation of this article anywhere else.

CROSS EXAMINATION:

I saw this German text which I just translated first on Thursday last week, just a week ago, when Mr. F. M. Warden called me up on the telephone and asked me if I could make a translation for him of a German scientific text. He met me on that day and showed me the text, asking me to translate several paragraphs of it. I made a translation which I took notes and read the notes to him. Mr. Warden thereupon asked me whether I was willing to testify to the accuracy of this translation, to which I agreed. That was the entire extent of our conversation. I was not shown any drawings or sketches of apparatus. I was given no explanation as to the art to which this translation relates.

I made no changes in my notes, except that I replaced one word by a better fitting word. The change that I made was I replaced the word "constructed" with "placed" after consulting the dictionary.

Referring to the German text and to the word "abgeschlossen", I translate that as "closed up."

The principal parts of the verb abgeschlossen are ab and geschlossen.

Ab has only the meaning of strengthening the verb geschlossen. It means shut off, closed up. The ab in itself has no specific meaning and only nullifies the verb.

There is a form geschlossen in the German language coming from the infinitive schliessen. The verb schliessen has a number of meanings. It means to conclude, to lock out, to close, to separate, and various other meanings.

The word abgeschlossen has two meanings, a concrete meaning, closed up, and an abstract meaning, concluded, as for instance, a treaty is concluded or a contract is concluded.

The infinitive of the word abgeschlossen is abschliessen.

The complete verb of this sentence which includes the word abgeschlossen is in the passive voice in the sentence.

The meaning of this sentence which says "closed up" is that a free communication between the Permutit layer and the outside is prevented.

The word ab can mean off under certain circumstances, as in the verb abrufen, to call off, but it does not mean off in connection with the verb schliessen.

The grammatical subject of the phrase wird abgeschlossen is "sie", which is a personal pronoun. It is never known as a relative pronoun.

Sie is translated in this sentence by "It."

x-Q. 35. In view of the fact that sie is never a relative pronoun, how can you tell what "it" means in this sentence?

A. I can tell that it means sie in this sentence by the fact that the noun Permutitschicht is feminine in the German language and, therefore, governs as its pronoun the feminine form sie for it.

The noun Permutitschicht is the antecedent of the pronoun sie. The noun could be substituted for the pronoun and give the same meaning.

x-Q. 38. Making this substitution and confining yourself strictly to the words given in that sentence, please state what it is that is said to be closed up.

A. The Permutit layer is said to be closed up and that includes the filtration liquid.

x-Q. 39. Is there anything in the sentence about the filtration liquid?

A. The paragraph refers to the fact that back washing should be prevented by the sand filter, and therefore the presence of a liquid is indicated.

The sentence itself does not indicate a liquid, but such must be understood as we are dealing with a filter in operation.

There is no reference to the filter being in use in this sentence.

My interpretation or understanding of this sentence is not influenced to any considerable extent by the sentences before and after the one under consideration, and in proof I may mention that it coincides with my original translation which I have made when Mr. Warden showed me this passage previously to my having read the article.

In my understanding of the sentence and visualization of the filter, it seems to be the liquid which rests upon the Permutit and the same is at a height of one-third to one-half meter above the Permutit layer closed up from the outside by the sand filter.

x-Q. 45. Supposing that you limit your view to the words in the sentence; what does the sentence itself say closes up the permutitschicht.

A. The word "closes up" refers that it separates the Permutit layer from the outside.

x-Q. 46. Supposing that you limit your view to the words in the sentence; what does the sentence itself say closes up the Permutitschicht?

A. The sand filter closes up the Permutit layer.

The word über means in this sentence "above."

It has no other meaning in English.

In combination with verbs über may mean over, like übersehen, meaning overlook. Referring to the photostat copy of the German article by Gans and particularly on page 198 thereof, under "Process IV", in the fifth paragraph, and in line 9 of this fifth paragraph, I translate "If we supply a water with a diluted Ca Mn_2O_5-solution, we are after sterilization able to free the water again quantitatively from the disinfection medium Ca Mn_2 O_5 by simple filtration through the above mentioned Manganoxydulzeolith, and to make it suitable for consumption."

In translating this sentence, I gave the meaning of through to the word über, as a technical term.

I mean to say that über in ordinary colloquial German means only above, if used alone. In the sentence which I have translated, it is used as a technical term in connection with filtrieren as über filtrieren, which can mean only to filter through.

I do not recollect of having heard the expression "to filter over." Referring to the sentence containing the word abgeschlossen, on page 199, and asked if the word "angebracht" could be translated as meaning "made", I should consider that a very inadequate translation. This word "made" would be somewhat similar to the word "constructed" first used by me. The verb made can be substituted for almost all words indicating activity, but with varying degrees of accuracy in the translation.

The word "Höhe" in the sentence containing the word abgeschlossen is part of an adverbial phrase indicating locality. The entire adverbial phrase is "in zirka ⅓ bis ½ m Höhe." The word "in" in this adverbial phrase is a preposition and governs the dative case. The preposition "in" governs sometimes the accusative and sometimes the dative case. The word Höhe by itself is a noun. This noun is in the singular. I decline it Die Höhe, der Höhe, der Höhe, die Höhe. The dative is der Höhe, and the accusative is die Höhe.

The words die and der are forms of the definite article.

If the definite article were not used with the word Höhe, I could not by merely looking at the preposition say whether it

was dative or accusative, but I can say it with absolute certainty by looking upon the verb. The verb is "angebracht ist."

x-Q. 69. Supposing the words "angebracht ist" occurred in connection with the words "in Höhe"; could we translate them as meaning "is constructed in height"?

A. No, I only could translate them by "constructed at a height."

x-Q. 70. Does the word Höhe in German ever mean depth?

A. Yes, it does.

Asked whether it is not a practice in German frequently to refer the measurement of a mass of material to its lower surface and speak of it as a height, whereas in English we are accustomed to speak of it as a certain depth, I reply that it is rather unusual to use it in this sense, and then it is used without a preposition. There are few instances where Höhe might indicate depth.

Referring to the paragraph preceding the one containing the word abgeschlossen, and in the second line thereof, I find the words "die Höhe" and I translate it by height. Translating the words, starting with die Höhe and including the following word "wassers", "the height of the Permutit layer depends upon the degree of hardness of the respective waters and of the filtration speed." In this sentence the thickness of the Permutit strata is meant.

Coming back again to the sentence containing the word abgeschlossen, the meaning of the word "das" immediately after abgeschlossen and before in is "which."

The word "in", immediately following the word "das" often has the meaning of the word "in" when translated into English.

The word "das" has as an antecedent the word "Sandfilter."

RE-DIRECT EXAMINATION:

Now that I have studied this article further, and particularly this disputed sentence, under the guidance of opposing counsel in a voluminous cross examination, I have not changed my opinion on any part of the translation.

Defendant offers in evidence the three sheets, numbered 1, 2 and 3, produced by the witness and marked Defendants' Exhibit, Dr. Noe's original translation.

These three sheets are in my own handwriting.

Defendant offers in evidence the front cover page of Chemical Abstracts, December 20, 1921, showing the name A. C. Noe, and it is marked Defendant's Exhibit, Chemical Abstracts List of Abstractors.

HENRY L. NACHMAN, testifies for defendants.

DIRECT EXAMINATION:

My name is Henry L. Nachman; age, forty-three; residence, 6944 Vernon Avenue, Chicago, Illinois; occupation, associate professor of thermodynamics at Armour Institute of Technology, Chicago, Illinois. I was born at Sommerfeld, Germany.

I went to school in Germany until ten years of age and completed my education in America in mechanical engineering, during which time I read widely in German technical magazines, and have continued to do so since. I have degrees as follows: Bachelor of Science in mechanical engineering, Armour Institute, in 1902; Master of Science, same, 1906.

I have been professor at Armour Institute or some other institution for eighteen years.

In my work as professor a practical working knowledge in technical German is very useful, but not essential. I have such knowledge.

I have translated an article by Dr. Gans, marked Defendants' Exhibit, Gans April 15, 1909, Article.

This came to my attention through being called on the telephone by Mr. Usher, reference librarian of Crerar Library, Chicago, and asked whether I would be willing to translate an article for a gentleman who had inquired at that library. I met Mr. Knight and he handed me the article. I greeted Mr. Knight and he handed me an article, and, without any explanation, pointed to a certain paragraph and asked me to translate the same into English, which I did. The total time spent in Mr. Knight's room was approximately fifteen minutes. After translating the paragraph, I naturally inquired if there were any controversy on the translation and Mr. Knight merely mentioned that a patent litigation was involved, and I assumed that the Permutit Company must be in question. As I remember it, there were no names mentioned. Just before leaving, Mr. Knight showed me translations of this same paragraph made by a number of other men. I remarked that it seemed incomprehensible to me that any other meaning could be intended except the meaning I had given in my translation.

I have translated all of pages 197, 198 and 199, of the exhibit.

I read into the record my translation of the particular paragraph referred to:

"The Permutit layer rests on a fine sand which becomes coarser toward the bottom. At the top it is best closed

off by a sand filter which is fastened at about one-third to one-half meter above the surface of the Permutit layer. In some circumstances the sand filter may be advantageously replaced by a limestone filter, for instance, with water containing iron or acid. This arrangement of the upper sand or limestone filter serves to prevent the washing away of the light Permutit during the counter-flushing process or back-washing process."

The translation is offered in evidence, and marked "Defendant's Exhibit, Nachman Translation of Gans Article."

I have had no communication from anyone representing the parties in this case, from that conversation in the La Salle Hotel, until a few minutes ago.

The translation I have produced of the Gans article is both complete and correct.

Referring to the translations purporting to have been made by Alfred Mueller, by Alexander Green, by Bernhard R. Regen, C. V. Bertsche, these translations are incorrect in that they give the impression that the layer of sand rests immediately upon the surface of the Permutit, while there can be no doubt that the meaning is that the sand is placed at a distance of one-third to one-half meters above the Permutit layer, with this intervening space between.

CROSS EXAMINATION:

I assumed that the Permutit Company must be in question, because the word "Permutit" is involved in this paragraph and I am somewhat familiar with the Permutit water softener. I knew there was a Permutit Company in America, because, in connection with my work, I am acquainted with the machinery and appliances used in power plants; second, a number of Armour Institute graduates, whom I know very well, are employed by the Permutit Company.

FELIX STERN, testifying for defendants:

DIRECT EXAMINATION:

My name is Felix Stern; age, forty-three; residence, 2815 Pine Grove Avenue, Chicago; occupation, attorney at law. I was born in Germany.

I was educated at the University of Munich; was later at the University of Berlin; took English courses there; and have been translating from either language into the other daily since

fifteen years. I have the degree of Electrical Engineer at Munich.

I practice patent law and specialize in the solicitation and prosecution of patents in foreign countries. In that connection the reading of German and other foreign language technical matter is daily necessary.

I saw Defendants' Exhibit, Gans Article of April 15, 1909, first about ten days ago. It was shown me by Mr. Greist, Jr., of Messrs. Cromwell, Greist & Warden. He brought it to my office. Mr. Greist, Jr., indicated two paragraphs of the article on page 199, and wanted me to translate same. I dictated the translation to a stenographer in my office. If I remember right, Mr. Greist spoke of it that the article was used in some litigation.

I translate it now as I translated it for him at that time.

"The apparatus consists of an iron or wooden filter. The height of the layer of Permutit depends upon the degree of hardness of the respective water and the speed of filtration. The efficiency is the larger the slower the water flows through the filter of Permutit and the finer the grain which the Permutits have.

"The layer of Permutit rests on fine sand which increases in coarseness towards the bottom. Towards the top it is most advisably covered by a sand filter which is disposed at a height of about one-third to one-half meter above the surface of the layer of Permutit. The sand filter is replaced preferably under certain conditions by a filter of limestone, as, for instance, with waters which contain iron and with acid waters. This arrangement of the upper filter of sand or limestone furthermore is to prevent that upon back-wash the Permutits of specific low weight should be washed away mechanically."

CINCINNATI, May 29, 1922.

SIGMUND WALDBOTT testifies for defendants:

DIRECT EXAMINATION:

My name is Sigmund Waldbott. I was born at Muenchweiler a. A., Rhenish, Bavaria, Germany, age 57, reside at No. 625 Crown St., Cincinnati, Ohio. I am research Chemist at the Lloyd Chemical Research Laboratory, Cincinnati, Ohio.

I have gone thru the technical high schools at Kaiserslautern and Landau. Finally graduated in Chemistry and Chemical Technology at Polytechnic School in Munich. Re-

ceived degree of Ph. D. at the University of Bern, Switzerland. Was closely associated with Prof. John Uri Lloyd of Cincinnati, as his assistant for nine years. Was Head of the Department of Chemistry at the Ohio Mechanics Institute, from 1901 to 1918. Was Librarian of the Lloyd Library, Cincinnati, Ohio, simultaneously with my position as Chemist with Prof. Lloyd. Assisted in this capacity in the preparation of a new Edition of King's American Dispensatory by Felter-Lloyd. Since 1912 I am on the staff of abstractors of Chemical Abstracts, published under the auspices of The American Chemical Society. I am also a member of the German Literary Club of Cincinnati, which requires of its active membership the reading of at least one paper a year, in the German language.

In 1907 I was appointed Authorized Denatured Alcohol Chemist by United States Internal Revenue, First District of Ohio, which position I hold today.

Shown a photostat copy of pages 197, 198 and 199, of German text from Chemische Industrie marked "Defendant's Exhibit Gans Article of April 15, 1909", I translate full paragraphs four and five, of the right hand column of page 199 of this text as follows:

> "The whole apparatus consists of an iron or wooden filter. The height of the permutite layer depends on the degree of hardness of the water in question, and the speed of filtration. The efficiency becomes the greater, the more slowly the water flows through the permutite layer, and the finer the grain possessed by the permutites.
>
> The permutite layer rests upon fine sand which becomes coarser in downward direction. In upward direction, the permutite layer is best shut off by a sand filter, which is placed (appointed) at a height of about ⅓ to ½ m above the surface of the permutite layer. Under some conditions, it is better to replace the sand filter by a limestone filter, for example with iron-bearing and acid waters. This arrangement of the upper sand or limestone filter is further intended to prevent the mechanical loss of the specifically light permutites upon rinsing in opposite direction."

I first met Mr. Knight at the Lloyd Library on Monday, May 22d, at 1:30 P. M. and at that time made a translation of two paragraphs of that text.

I present you herewith with the original manuscript of that translation.

Respecting the illustration below the writing, I was re-

quested to make a sketch of the apparatus as it pictured itself in my mind according to the translation I just had made.

The defendant offers in evidence the manuscript translation and sketch marked "Defendant's Exhibit Dr. Waldbott's Manuscript Translation and Sketch."

The names of Dr. Francis P. Mason, Dr. Noe and Dr. Nachman were mentioned as having made translations of the same passage and having come to the same conclusion. It was also mentioned to me that others whose names I do not recall, pronounced the filter to be on the order of the Riedel filter.

The word "angebracht" involves a special effort in placing, which I though would be expressed by the word "appointed." The Standard Dictionary published by Funk & Wagnalls under "appoint" No. 5, gives the following definition "to provide with necessary or desirable fittings or equipments; fit out; furnish; equip, as, the house is miserably 'appointed'; used now only in the past participle."

The term Sandfilter as used in the German article designates in my opinion, not merely a layer of sand, but it means rather a bit of special apparatus consisting essentially of a supporting surface and a sand layer resting upon it.

Asked if a German Doctor, that is, a technically educated man, had intended to describe the sand filter as resting upon the bed of permutit instead of spaced above it, what German language would he have used keeping as close to the language of this German text as you can, so as to convey the idea that the sand filter had a thickness of ⅓ to ½ m, I reply:

"Nach oben hin wird die Permutitschicht am besten von einem Sandfilter abgeschlossen, das in zirka ⅓ bis ½ m. Höhe der Oberfläche der Permutitschicht aufliegt."

ANN ARBOR, Mich., May 31, 1922.

ALFRED O. LEE testifies for defendants:

DIRECT EXAMINATION:

My name is Alfred Oughton Lee, 48 years old. I reside in Ann Arbor, Michigan. I am a Professor of Modern Languages in the Colleges of Engineering and Architecture, University of Michigan. I am chairman of my department and have been for three years.

I have given scientific reading courses in German in the fields of Chemistry, Physics and Biology in the Graduate School of the University. I am the official examiner in German and

French of the candidates for the doctor's degree in Science, all of whom are required to translate from current scientific foreign journals in their special fields of learning. I am in charge of all translations made thru the University Bureau of Engineering research at the request of manufacturing concerns of the State of Michigan.

I have been connected with the department of Modern Languages of the Colleges of Engineering and Architecture for fourteen years and my duties consisted in teaching of German, French and Spanish.

I was educated in Germany, graduated from The Gymnasium, Heidelberg, after taking the complete nine years course there, and after five years of further study in Germany and France received a Doctor's degree from the University of Berlin. Returning to the United States I was for several years engaged in editorial work, first as office editor of the New International Encyclopeadia (Dodd, Mead & Company, New York); then as office editor of Webster's New International Dictionary (G. & C. Merriam Company, Springfield, Mass.). I specialized in the editing and writing of scientific articles and definitions. When I took up teaching I was first instructor in German at Purdue University, the State Engineering College of Indiana, 1906-1908. I then came to Michigan.

I have read the paper marked Defendant's Exhibit Gans Article of April 15, 1909. I translate into English that portion of it which covers full paragraph five of the right-hand column of page 199 of this text as follows:

"The permutit bed lies upon fine sand which becomes coarser toward the bottom. In a direction upward it is best closed off by a sand-filter which is fixed at a distance of about one-third to one-half meter above the surface of the permutit layer. The sand filter may under certain conditions be replaced by a limestone filter, for instance in connection with water containing iron and acids. This arrangment of the upper sand or limestone filter is furthermore intended to prevent the specifically light permutites from being flushed away mechanically in the case of back-washing."

This German text could not be correctly translated so as to have the upper sand-filter rest directly upon the bed of permutit without leaving a space between them.

The author uses the word "nach oben hin" which means in a direction upwards. He then uses the words "das" referring to the filter, "uber" der oberflache der Permutitschicht angebracht ist." The use of these words clearly indicates to me that he wished to state that the filter is fixed a definite dis-

tance above the surface of the permutit layer. If he had wished to express that the sand filter was located directly on the permutit layer he would not have used the words "uber" and "angebracht", but would have used in place of "uber", "auf" and in place of "angebracht", "liegt."

CROSS EXAMINATION:

I translate the following German sentence into English:

"Nach oben hin wird die Permutitschicht am besten von einem Sand-filter abgeschlossen, das in zirka ⅓ bis ½ m. Höhe der Oberfläche der Permutitschicht aufliegt."

In a direction upwards the Permutit layer is best closed off by a sand-filter which in a depth of one-third to one-half meter lies upon the surface of the Permutit layer.

Asked to translate the following German sentence into English: "Nach oben hin wird sie am besten von einem Sand-filter abgeschlossen, das in zirka ⅓ bis ½ m. Höhe unmittlebares über der Oberfläche der Permutitschicht angebracht ist."

I point out that there is a mistake. It should read "unmittlebar" and not "unmittlebares". As so corrected I translate "In a direction upward it is best closed off by a sand-filter which is fixed at a distance of about one-third to one-half meter directly above the surface of the permutit layer."

"Angebracht" I should translate as attached, fixed, fastened, and sometimes as placed. "Angebracht" does have the meaning of "arranged".

"Wie bringen wir diese Bilder an" might mean "How shall we arrange these pictures or how shall we attach these pictures?"

The word "über" sometimes has the meaning of "over". The German word "abgeschlossen" may have the meaning of "terminated".

I should not say that the German phrase or expression "nach oben hin" ever has the meaning in English of "at the top". If I would want to express "at the top" in German I would simply say "oben".

Given the translation of the German phrase "nach oben hin wird sie am besten von einen Sand-Filter abgeschlossen," as follows: "Toward the surface it is best finished off by a sand-filter", I do not think that this translation is correct because the word "surface" is used and the word "oberfläche" is not used in the German sense. "Nach oben hin" I would translate in an upward direction and not toward the surface.

x-Q 17. I will translate the same German text which I set

out in x-Q. 16 in the following manner and then ask you to state whether or not my translation is erroneous as violating some grammatical rules of the German language. My translation is as follows: "Toward the top it is best finished off by a Sand-filter". Will you please answer the question above this sentence?

A. There are no violations of grammatical rules in this translation. But as I understand the phrase it means not towards the top of the permutit layer but toward the top of the container.

x-Q. 18. Referring to the German text of the Gans article of April 1909, about which you have been testifying what is it that is said to be "closed off" as the word "abgeschlossen" is translated by you?

A. The layer of permutit.

REDIRECT EXAMINATION:

After this very thorough cross-examination I have not changed my opinion as to the correct translation of this sentence about which I have been interrogated.

Deposition closed.

Depositions for Plaintiff Stipulated from Detroit (Wadham) Case.

NEW YORK, July 17, 1922.

GEORGE C. O. HAAS, a witness for Plaintiff, testifies:

DIRECT EXAMINATION:

My name is George C. O. Haas; age 39; residence 323 W. 22nd St., New York City; technical translator.

I studied at Columbia College, receiving the degree of A. B. in 1902. I studied chemistry and physics in the college course, continued my studies in Columbia University receiving the degrees of A. M. in 1903 and Ph.D in 1909. Served as tutor and instructor at the College of the City of New York from 1904 to 1916, being instructor in German from 1911 to 1916. Was translator for the Department of Justice, Washington, in 1917, and censor U. S. Department of Justice in 1917 to 1920. Did special translation work for the office of the Attorney General State of New York, New York City Bureau, during 1918. Have been familiar with German Scientific literature since my college days.

This typewritten manuscript comprising 14 pages, handed me, is a correct translation prepared by myself of an article by Dr. R. Gans, published in a periodical entitled Die Chemische Industrie, Vol. 32, No. 8 (632) pp. 197 to 200, and dated April 15, 1909; the article is entitled as translated, "On the Technical Significance of the Permutits (artificial Zeolitic Compounds)."

The manuscript translation identified by the witness offered in evidence and marked "Complainant's Exhibit 37, Haas Manuscript Translation of Gans Article of April 15, 1909."

The note referred to on page 4, preceded by an asterisk, is a comment by the translator, myself, on the word "Austauch" which appears in the article in question, and explains that this is an obvious misprint for "Austausch". This correction was based on the fact that the term "Austausch" occurs frequently in the article and that the chemical formulas adduced in this connection gave evidence to the translator that chemical exchange was here referred to.

The footnote preceded by an asterick on page 5, is a note by the translator, myself, and merely corrects the spelling "Zinoxydul" to "Zinnoxydul".

At the bottom of page 9 of this manuscript Plaintiff's Exhibit 37, the footnote preceded by an asterisk, is a note added

by myself explaining that the German sentence translated is defective, the word "werden" being necessary to complete the grammatical structure.

The photostat copy shown me is a photostat copy of the Article by Dr. Gans in Vol. 32 of Die Chemische Industrie which is the basis of the translation to which I have referred. This identification I make on the basis of careful comparison with a copy of Die Chemische Industrie in the New York Public Library.

My translation of the 4th and 5th full paragraphs on page 199 of this photostat copy which commences "Die Apparatur", read from my translation of the entire article is:

> "The equipment consists of an iron or wooden filter. The depth of the permutit layer is determined according to the degree of hardness of the water in question and the speed of filtration. The efficiency is the greater, the more slowly the water flows through the permutit filter and the finer the grains of the permutit are.
>
> The permutit layer rests upon fine sand which grows coarser toward the bottom. In the upward direction it is best terminated by a sand filter, which is applied to a depth of about ⅓ to ½ meter over the surface of the permutit layer. The sand filter is more suitably replaced, under various circumstances, by a limestone filter, in the case of ferriferous or acid waters, for example. This arrangement of the upper sand or limestone filter is further intended to prevent the permutits which have a lower specific gravity, from being mechanically carried away in case of back washes."
>
> The photostat copy of German text identified by the witness is offered in evidence and marked "Complainant's Exhibit 38, Gans Article of April 15, 1909."
>
> It is stipulated between counsel for the opposing parties that pages 197, 198 and 199 of the photostat copy "Complainant's Exhibit 38 are identical with the corresponding pages of Defendant's Exhibit Gans Article of April 15, 1909, and that page 200 is a true and correct photographic copy of page 200 of the same article by Dr. Gans.

My attention was called to this Article by Dr. Gans as follows:

I came to the office of Mr. Rice in order to interest him in my work as a technical translator. Mr. Rice at once said in

substance "We shall soon see whether you are a satisfactory technical translator." He thereupon, after explaining that he did not regard the contemplated test as a sensible one, gave me a photostat reproduction of a German article which I have since found to be the article by Dr. Gans previously referred to. No explanations were made as to object of having this translation made and I was sent into another room where I prepared a rough translation of two German paragraphs without reference books. I produce the manuscript of that first translation which I made.

Manuscript produced by the witness offered in evidence and marked "Complainant's Exhibit 39, Manuscript Notes of First Translation by the Witness Haas."

I was sent to Mr. Rice by Mr. F. N. Waterman of 128 Broadway, who said that there was a possibility that Mr. Rice might wish to have me make him a translation of certain disputed passages of German text involved in a case relating to some sort of filtering.

CROSS EXAMINATION BY MR. KNIGHT:

I am conducting a business of my own as "technical translator", at 323 W. 22nd St., New York City, and I do business under my own name. You are correct in understanding that I do this work at home. I have been engaged in business for myself since the Autumn of 1921. I have had no technical experience. The scientific instruction received by me as detailed in my direct was not given in the German language. I have never lived in Germany. I was taught German in childhood, learning it before English.

In 1917 in the Department of Justice, Washington, where I was employed as translator I had 46 persons employed on the same tasks as myself, but I was one of the six supervisory translators who were engaged at a higher rate of pay. I was censor U. S. Department of justice from 1917 to 1920. I never had any official information as to how many persons were employed as censor by the U. S. Department of Justice from 1917 to 1920. It is my personal opinion that there were only two, that is, one beside myself.

At the beginning my work as censor required that my whole time be given to papers in the German language. Toward the end of the period of service about nine other languages had to be added. There were of course always a few documents or

letters in the English language as well. I was not under Civil Service.

The passing of the letters and other matters at Ellis Island where I was stationed was entirely in my hands I reported only what seem to be of interest to the Department of Justice. In 1917 when I was translator for the Department of Justice the language my work involved was principally German and chiefly matter returned by the other translators as illegible, obscure or too difficult. In default of competent parties I also handled a small quantity of Italian and Dutch. The foreign languages that any of my work covered involved a knowledge and use of German, French, Dutch, Danish, Swedish, Norwegian, Spanish, Italian, Portuguese. This answer is not intended to convey the impression that I was familiar with all of these languages during all of the period covered by Q. 2. Nor does it mean that my knowledge of them is equally extensive.

The courses I have taken in chemistry, physics and mechanics, particularizing as to each, are a course in general Inorganic Chemistry, under Prof. Chas. F. Chandler and instructor M. C. Whitaker, in 1901-2; and a course in general physics, including elementary mechanics under Prof. O. N. Rood and others. None of this instruction was given in German. For the last 20 years I have at various times investigated matters connected with chemistry, physics, mechanics in German and French works as well as in English, and have discussed these subjects with experts.

The term "instruction" seems to me clearly to include self-instruction and as a trained scholar it has for many years been my custom to learn things by personal investigation.

x-Q. 39. Has any of your work involved technical literature or discussions with technical men concerning material, methods, or apparatus in the filtering or water softening arts? A. I may have read something on the subject in years past but cannot recall doing so in detail.

x-Q. 40. Then you don't pretend to have any technical knowledge of water filters or water softeners that would be of value to you in translating from technical German on those subjects, is that correct? Please answer yes or no and qualify it in any way that you can see fit.

A. It is not my understanding that a technical translator in order to do his work need qualify as an expert in every field he is likely to cover.

By Mr. Knight: The foregoing statement of the witness is objected to as wholly irresponsive to the question.

x-Q. 41. Please answer Q. 40 which I ask you to read from the record.

A. I claim to have sufficient technical knowledge to enable me to translate technical German relating to water filters or water softeners as well as to other technical subjects.

x-Q. 42. What, if any, technical knowledge have you on the subject of water softeners?

A. The question cannot be answered truthfully, in accordance with my oath, briefly.

x-Q. 43. Please state upon the record in whatever way you think most complimentary to yourself whatever you know technically concerning water softening apparatus, using base exchange silicates as a water softening agent?

A. As I have previously stated, I wish to qualify as a technical translator and not as a specialist in any particular technical process.

x-Q. 44. Am I to understand from your complete evasion of the last question that you can think of nothing whatever that you can state concerning water softeners using base exchange silicates as a water softening agent?

A. You are not.

x-Q. 45. Then please state what you do know on that subject as asked you in x-Q. 43 which I ask you to read from the record now before you?

A. It seems to me that this question tends to qualify me in a special art and I therefore prefer not to answer it.

In numerous places in "Plaintiff's Exhibit 37 Haas Manuscript Translation of Gans Article of April 15, 1909", the word "permutit" occurs. This word "permutit" is a special designation, somewhat of the nature of a trade name, given to certain artificial zeolites, presumably by Dr. R. Gans. The word is now recognized in chemical treatises as the designation for such compounds. I know this from study of chemical treatises. I found it in at least two works but cannot give the precise author and title from memory. The one is an English treatise on chemistry in at least five and possibly nine volumes in which the word is spelled "permutit", and the other is a German treatise in which it is given as "Permutit." I recall consulting also another treatise in which the name always appeared in quotation marks.

I do not recall the authors and titles. The German work mentioned has in addition to a discussion of these compounds a bibliographical list of articles by Dr. Gans and others on this subject. I mention this to show that I am speaking of an actual work, which I consulted at the New York Public Li-

brary. These publications contained no illustration of water softening apparatus. I do not remember when I first saw these publications. I have used these works at various times during the past year whenever necessity arose. My answer applies to all three of the publications. These publications were not called to my attention by any one. I mean that these three publications are standard works and I occasionally consult them. These works are in the chemical room at the New York Public Library, and can be obtained without call slips. In the search for information, I go from one to another, frequently consulting four or five volumes before finding what I am looking for. When any item of information is contained in several of them, the question as to whether they are standard works becomes largely academic, especially is this the case when they quote detailed literature on the subject.

The work of a technical translator includes in my understanding of the matter a study of the particular art with which any matter to be translated deals. In fairness to my customers I do not supply translations without making such investigation as may be desirable.

I made such a technical investigation of the water softening art with the use of base exchange silicates as the water softening agent for the client for whom I am today testifying. I investigated it sufficiently to solve such problems as were in my mind, not sufficiently to deliver a discourse on the subject.

x-Q. 58. Please relate in detail all the investigation you made for the purpose of this translation and testimony, stating when it began, with whom you talked, what works you consulted and where and how many hours or days of work were involved in what you have termed this investigation?

A. I have already mentioned that I do not recall the titles of the works consulted. I further stated that I consulted them at the New York Public Library. I have not at hand any records of the precise days and hours when this was done but should say approximately two afternoons or their equivalent were spent on this matter in the week ending July 15th. Some of the work may have been done in the previous week. I spoke with no one regarding the matter, so far as I can recall.

I have never seen a permutit water softener. I have never seen any make of water softener using base exchange silicates as the water softening agent. I have never seen a model or experimental apparatus of either a permutit or other make of water softener using base exchange silicates as the water softening agent. I have never seen an illustration of a permutit

or other make of water softener using base exchange silicates as the water softening agent.

x-Q. 65. When you were making the translation which is now marked "Complainant's Exhibit 37" did you have in your mind's eye any picture of what you have called the "equipment" described in the German text, from which you translated it, that is, Plaintiff's Exhibit 38?

A. It is not clear to me whether you mean to ask whether I had in my mind's eye a picture of the equipment before reading the German text or after reading it.

I do not know what the initial "F" or Mr. F. N. Waterman's first name stands for.

I met him on June 29, 1922. I have never done any work for him. I found, however, to my surprise that he was familiar with my work.

Mr. Geo. C. Arvedson of the patent department of the National Automobile Chamber of Commerce suggested my seeing him and mentioning his name. He had found my translations far superior to those he had previously been having prepared and was endeavoring to bring me in connection with other persons that could make use of my services.

x-Q. 71. Well, now, aside from "boosting your wares," what did he say about his reason for wanting you to see F. N. Waterman?

A. He assigned no reason. Mr. Arvedson has always been extremely kind to me for no reason that I have discovered and has at various times mentioned at least ten different parties who have considerable translation work done. He frequently characterized them in a casual way as having much work or at present making use of poor translators.

My impression is that Mr. Waterman is interested in some case connected with automobile patents and that suggested him to Mr. Arvedson's mind. I wish to add that the reference to "superior translations" in my answer was necessary as being in accord with the truth, in other words, that is what he said.

x-Q. 72. How many other names did Mr. Arvedson give you at the same time that he mentioned Mr. Waterman?

A. Four. He also alluded to one he had previously mentioned to me, making five.

x-Q. 73. Well, the sum and substance of the whole matter is that you needed more work, and he being friendly to you, suggested where you might get it, isn't that so?

A. Yes.

I called on Mr. Waterman on June 29, 1922, I should say about 1 P. M. I was there perhaps five minutes.

Mr. Waterman said Mr. Rice was interested in a case relating to a filter in which considerable importance was attached to the translation of certain German technical matter. He mentioned no details relating to the case except that it was the case of a filter containing several layers. He then dictated a letter to Mr. Rice and asked me to go and see him at once.

x-Q. 78. Did he tell you that he had been an expert witness in this case?

A. He did not.

x-Q. 79. Where is this letter that you got from Mr. Waterman?

A. I cannot say.

x-Q. 80. What did you do with it?

A. I delivered it to Mr. Rice.

x-Q. 81. Have you a copy of it?

A. I have not.

x-Q. 82. You have said that you have no copy of this letter. Have you ever had a copy in your possession?

A. No. I never made a copy, nor was furnished with one.

x-Q. 83. I don't think you quite understand me. Have you ever seen any copy of it except the original, whether you made it or somebody else made it?

A. No.

By Mr. Knight: I am not interested in any copy of this letter. I am very much interested in the original, and if it is found later today ask that it be produced.

x-Q. 84. Please read from the record the sentence that I am about to dictate to the notary, and translate it into German:

"The path leads upward to a tavern which overlooks a ravine about ½ mile in depth. This tavern terminates the path in this direction."

Question is objected to as irrelevant and immaterial; also objected to as outside the scope of the direct examination.

"De Pfad fürt hinauf nach einer—welche eine etwa 1/22 Meile tiefe—überschaut. Diese—schliesst den Pfad in dieser Richtung hin ab."

I omit two nouns for which I cannot make a suitable equivalent at this moment.

x-Q. 85. What nouns are they, in English?

A. Tavern and ravine.

x-Q. 87. What German word did you use in translating the English word "direction".

A. Richtung.

x-Q. 88. What German word did you use in translating the English word "upward"?

A. The word "hinauf".

x-Q. 89. How do you define the German word "tiefe".

A. It is equivalent to the English word "deep" and denotes "extending for a considerable distance downward" when considered from above it may also have similar meanings such as are connected with the English word "deep".

x-Q. 90. Would you then speak of "the *deep* of the ravine"?

A. I might do so considering it from above.

x-Q. 91. That would not be good English, would it?

A. No, I didn't think you were using the words, except as crude equivalents of some German words.

x-Q. 92. Please read the sentence which I am now dictating to the notary as part of this question, and translate it into good technical German:

"The greatest permissible height at which the barometer can be placed, without making corrections, is a height of about 100 meters above the surface of the sea, where the height of the mercury column of the instrument will be about 760 millimeters."

By Mr. Knight: The witness is handed a large sized pad, a lead pencil, and Adler's German and English dictionary and asked if he would like to have anything else.

A. "Die grösste zulässige Höhe in welche das Barometer, ohne Berichtigungen zu machen, gestell werden kann, ist eine Höhe von etwa 100 Meter über der Oberfläche des Meeres, wo die Höhe der Quecksilbersäule des Instruments etwa 760 Millimeter betragen wird."

By Mr. Knight: In preparing preceding answer the witness also used "Muret-Sanders enzyklopädisches Wörterbuch." Deutsch-English.

REDIRECT BY MR. MASSE:

Mr. Massie: I have received from Mr. Waterman's office a carbon copy of a letter dated June 29, 1922, addressed to James Q. Rice, one of the counsel in the present case, bearing the initials at the bottom "FNW/DH". I ask the notary to mark this "Complainant's Exhibit No. 40," for purposes of identification.

I saw the letter of introduction from Mr. Waterman to Mr. Rice and plaintiff's Exhibit 40 seems to me to be an exact copy of the letter.

Looking at the dictionary the words still to be supplied in German to my German translation in answer to x-Q. 84 are "Schenke" and "Schlucht". I retranslate the sentence given to me in x-Q. 84, so as to make the same complete.

A. "De Pfad führt nach einer Schenke welche eine etwa ½ Meile tiefe Schlucht überschaut. Diese Schenke schliesst den Pfad in dieser Richtung hin ab."

RECROSS BY MR. KNIGHT:

Rx-Q. 96. I show you complainant's Exhibit 39, Manuscript Notes of First Translation by the Witness Haas, and ask you to look at line 13 of the body of the notes and say what word you originally had and erased where the word "terminated" now is.

A. I do not recall. This erasure and correction were made at the same time that the translation on this sheet was prepared, namely, on June 29, 1922. The original tentative translation now erased may possibly have been "closed off", "shut off" or something of the kind, which I decided to replace by a more accurate word.

In making the translation, "Complainant's Exhibit 39", I did not use any books, papers, notes or memoranda of any kind.

JULY 18, 1922.

By Mr. Haas: The following are the books referred to in my testimony of July 17, 1922, as having been consulted by me at the New York Public Library:

1. A Text book of Inorganic Chemistry, edited by J. Newton Friend, London, Charles Griffin & Co. Volumes 1, 4, 5, 8 and 9 have appeared, 1914-1921. On pages 95-96 of volume 4 there is an account of the permutits (vol. 4, by H. F. V. Little, London, 1917). This is the English publication to which I referred.

2. Handbuch der Mineral-Chemie, edited by Hofrat Prof. Dr. C. Doelter, vol. 2, 2d part, Dresden & Leipzig, Theodor Steinkopf, 1917. On pages 375-376 there is an account of the Permutits. The bibliographical list referred

to in my testimony is on page 376 of this book. This is the German publication to which I referred.

3. The Condensed Chemical Dictionary, F. M. Turner, Jr., Technical Editor. New York, Chemical Catalog Company, Inc., 1919. Article "Permutit" on page 367.

This is the publication to which I referred in my testimony as having the word *permutit* enclosed in quotation marks.

ABRAM LIPSKY, a witness for plaintiff, testifies:

My name is Abram Lipsky, I reside at 1001 Faile St., New York, and I am a teacher of German at the Stuyvesant High School, New York City.

I am a graduate of the University of Rochester, Ph. B. I studied one year at the University of Berlin. I have a Ph. D. degree from Columbia. Also an M. A. I have been teaching German for fifteen years. I have also had some experience as a translator. Translated some chemical stuff for Prof. Chandler of Columbia University; did a lot of other translation for Schaff-Herzog Encyclopedia. The University in Berlin is in the city of Berlin, Prussia. The studies conducted at the University of Berlin were in German.

I have translated scientific German.

I translate from Plaintiff's Exhibit 38, Gans Article of April 15, 1909, and particularly the fourth and fifth full paragraphs on page 199, commencing "Die Apparatur", as follows:

"The apparatus consists of an iron or wooden filter. The thickness of the purmutit layer depends upon the degree of hardness of the particular water and on the speed of filtration. Its efficiency is the greater the more slowly the water flows through the permutit filter and the finer the grain of the permutits.

"The permutit layer rests upon fine sand which gets coarser with the depth. Above it is best terminated by a sand filter which through the thickness of about ⅓ to ½ meter is fixed on the upper surface of the permutit layer. The sand filter under certain conditions is better replaced by a limestone filter, for example, with water containing iron or acid. This arrangement of the upper sand or limestone filter should further prevent the specifically light permutits from being mechanically skimmed off in back washes."

My attention was first directed to this German text which I have just translated into the record as follows: About two months ago I received a note from Miss White asking me to call. She showed me these paragraphs and told me to translate them. I sat down with a piece of paper and a pencil and wrote the translation. I identify the manuscript shown me as what I wrote at that time.

The three sheets of manuscript notes are offered in evidence and marked "Complainant's Exhibit 41 Manuscript Notes of Dr. Lipsky."

Referring to Complainant's Exhibit 38 the German text therein translated is from the words "Die Apparatur" to "angebracht ist."

Referring to Complainant's Exhibit 38, page 199, fifth full paragraph, commencing "Die Permutitschicht" and the second sentence beginning "Nach oben hin" the verb in that sentence is "wird abgeschlossen" and is in the passive voice.

It is always necessary to caution English speaking students when they come to consider the passive voice that it is something peculiar to German, for which what is usually called the passive voice in English is not a correct equivalent. The passive voice in German signifies action. What is called the passive voice in English frequently does not signify action but a condition or state of being. I can best give this by illustration. When you say in English "He is married" that might mean he is being married, as for instance, is being married in Grace Church, or it might mean "He is a married man." In German, that distinction is always indicated. He is in the act of being married in the true passive will be expressed by "wird verheiratet." The other idea that he is a married man would be expressed by using the word "ist" "ist verheiratet." The true German passive employs the word "wird." Referring to Complainant's Exhibit 38, the words "wird abgeschlossen" is a true German passive.

The principal parts of the verb "abgeschlossen" are abschliessen, schloss ab, abgeschlossen. We usually give another one "schliest ab."

Referring to the fifth full paragraph of "Complainant's Exhibit 38", commencing "Die Permutitschicht", and to the second sentence thereof, the subject of the verb "wird abgeschlossen" is "sie", which is a personal pronoun. Referring to the full paragraph 5, what is said to be "abgeschlossen" is "die Permutitschicht" which in English means the permutit layer.

CROSS EXAMINATION:

I do not know how the witness for the defendants have translated the two paragraphs which I have translated from Exhibit 38.

I do not think the second paragraph out of Exhibit 38 can be translated as follows:

"At the top it is best closed off by a sand filter placed about ⅓ to ½ meter above the surface of the permutit layer."

I think the phrase "in zirka ⅓ bis ½ m Höhe" refers to the dimension of "das." There are two things which make me think so. One is the position of it right close up to "das" and the other the very fact that it is there at all. Referring to what I mean by the fact that it is there at all, it seems to me that you could get the sense that you suggest without the use of that phrase.

The German text from which I had translated does not suggest to me the translation you have on the record in x-Q. 27.

The translation you have suggested would not be the meaning I understand it to convey.

Referring to the following sentence:

"At the top it is best closed off by a sand filter placed at height of ⅓ to ½ meter above the surface of the permutit layer";

and the German text of Plaintiff's Exhibit 38; this is not a correct translation of the sentence.

The translation which you have just given me is not also correct, because you cannot have two things correct at the same time.

All the German words which I can think of at present which mean "upon" are "an, auf, and über."

I translate into German the sentence "As far as heaven is above the earth by "So hoch wie der Himmel ist über der Erde."

In my original translation "Plaintiff's Exhibit 41" I gave six meanings in my translation to a particular word because I was trying to think of a suitable English equivalent and I wrote on the paper to help my mental processes.

You are not correct in understanding that as to all the other words in the German text but "a single suitable English equivalent" occurred to me. I didn't write down a flock of meanings for some of the other German words, because sometimes I do a thing one way and sometimes I do it another way.

I wrote down on the third sheet of this "Plaintiff's Exhibit 41" special comments about the word "das", "zirka", "Höhe", "in" and "angebracht", because Miss White, the notary now taking the deposition, suggested that I parse the words of the sentence.

I did not know there was a dispute on concerning the translation of this sentence.

I cannot tell the whole conversation that occurred between me and Miss White, or any other person on that occasion relating to this Gans article. I can't give you anybody's words, but I can give you the substance of some of the things that were said. Miss White said I would like to have you translate this for me. She gave me some paper and a pencil and the text. I sat down and translated it. I don't remember anything else that was said definitely. That is absolutely all I can remember.

I have known Miss White about 40 years.

I am 50 years old. I have known Miss White pretty well. I am not related to her by blood or marriage.

I was just introduced to James Q. Rice, one of the members of the firm in whose office we are now taking these depositions, in the hall.

I used no books in making the translation "Plaintiff's Exhibit 41".

I went over this Gans article after the day I made the first translation. Yesterday in room 1412, Mr. Massie's room, in this building, I went over it. I looked up some of the words in the dictionary; that is all.

Mr. Massie said, or he intimated, I do not know what he said exactly, that there was a question as to the meaning of "abgeschlämmt". He said he would like to have me pay particular attention to that word, and he handed me two or three dictionaries and told me to go ahead and consider it. He did call my attention particularly to other words that he wanted me to carefully consider. The word I have referred to is found on page 199, column 2, fifth full paragraph, last line of the paragraph.

x-Q. 65. Now, was that your whole conversation with anyone from this office about the scope and character of the work that you were to do in this translation, and for the purpose of this testimony of yours; if not, tell us the rest?

A. I don't understand your question.

x-Q. 66. Please read for yourself from the record x-Q. 65.

A. I remember what you said, but I don't understand what you mean by "scope and character". What do you mean by scope and character?

x-Q. 67. In asking questions of a Ph. D., A. M., etc., I have not sought to use exclusively the simplest language that was possible for I did not think it was necessary. However, that there may be no misunderstanding, please tell us anything else that Mr. Massie or anybody else in this office said to you concerning this Gans article from which you have translated or any part of it, or the testimony you were expected to give concerning it.

A. I think I have said that Mr. Massie asked me to go over that sentence. He thought the word "abgeschlämmt" required particular consideration, and he gave me those dictionaries. I said that I thought I could do it without dictionaries.

He thought it was a technical word for which I would need a dictionary.

I studied in the Berlin University German, philosophy, economics. That is all I seriously studied but I heard a great many lectures on subjects I wasn't deeply studying, specially studying. I heard lectures by Eric Schmidt on the history of German literature; and Brandl on Anglo-Saxon. I was not studying chemistry, physics or mechanics.

x-Q. 78. Please translate into German the following sentence:

"The meat was cooked in an iron pot which rests on a grid, over the burner of the stove. Near the top the stove was closed off by a hood which was arranged at a height of about 13 to 20 inches above the surface of the grid and which carried off the odors."

If you wish to use dictionaries and have scratch paper and pencil to work this out, we will be glad to furnish them.

A. Das Fleisch wurde in einem Topf gekocht welcher auf dem Bratrost über dem Brenner des Ofens ruht. Nach oben hin war der Ofen durch einer Haube eingeschlossen die etwa 13 bis 20 Zollen über der Oberfläche des Bratrosts angebracht war, welche die Gerüche abtrug."

By Mr. Knight: In preparing the preceding answer which the witness wrote out on the pad furnished him he used Adler's Dictionary.

x-Q. 79. Does the word "eingeschlossen" which you have used in your answer to x-Q. 78 mean "closed off" or "closed in"?

A. Well, it means both.

x-Q. 80. Would not the words "closed off" be better expressed in German by the word "abgeschlossen"?

A. It depends on what sort of object you are talking about.

x-Q. 81. Please translate into English the following sentence:

"Die grösste zulässige Höhe in welche das Barometer, ohne Berichtigungen zu machen, gestellt werden kann, ist eine Höhe von etwa 100 Meter über der Oberfläche des Meeres, wo die Höhe der Quecksilbersäule des Instruments etwa 760 Millimeter betragen wird."

By Mr. Knight: The books and paper are, of course, at your disposal.

A. "The greatest height to which the barometer can be conveniently placed without making corrections is about 100 meters above the surface of the sea where the height of the quicksilver column will amount to about 760 millimeters."

x-Q. 82. Please translate the following from English into German:

"The letter was covered by a blotter of a thickness of 1/16th to 1/8 of an inch which was placed upon the upper surface of the table."

Same facilities as before.

A. "Das Papier wurde von einem Stück Löschpapier bedeckt welches eine Dicke von etwa 1/16 bis 1/8 Zoll besass und auf der Oberfläche des Tisches lag."

x-Q. 83. Please translate into English the second and third sentences of the 6th full paragraph, column 2, page 199, of Plaintiff's Exhibit 38, beginning with the words "Hierfür" and ending with "hoher Schicht".

(Same facilities.)

A. "For this purpose, two filters of 2.4 meters thickness and 1.2 meters diameters each are built in. Each filter contains about 700 kilograms of centrifugally dried (450 to 500 kilograms air dried) permutits in a layer of about 70 centimeters thickness."

x-Q. 79. How do you translate into German the English word "height"?

A. Höhe.

x-Q. 80. In your translation of the sentence contained in x-Q. 78, I do not find this German word "Höhe". I show you your translation and ask you why?

A. It was not necessary.

x-Q. 81. Why not?

A. When I say the flag is 200 feet above the ground I don't

have to say the flag pole is 200 feet in height above the ground. The idea is expressed fully without those words.

There is an active voice in the German language. It does not always have the same characteristic as the active voice in the English language. I will point out one difference, when I say in German "Ich lasse mir das haar schneiden". If you were talking English and had the same idea in your head you would say "I am getting my hair cut". The difference is you have a passive idea there, "my hair is being cut".

OTTO LUTHY, a witness for plaintiff, testifies:

DIRECT-EXAMINATION BY MR. MASSIE:

Q. 1. Please state your full name, age, residence and occupation?

My name is Otto Luthy. I am 77 years old and reside in Hackensack, N. J. I am a research chemist in Wallerstein Laboratories, New York.

I got my final education as a technical chemist at the Swiss Polytechnic School in Zurich, and ever after that I was engaged in chemical pursuits, analytical and manufacturing up to the present time. I may say that I have been chief of laboratories and superintendent of chemical factories at times.

The instructions given at the Swiss Polytechnic School in Zurich were in German, in book German, the language Luther translated the bible in. Since I completed my schooling at the Swiss Polytechnic School I have used German in reading chemical literature and technical chemical literature; most of it is printed in German. I had access to the English printed books in the library here not so much as German books, most of my library consists of German books. Furthermore, I have been a member of chemical societies two of which send their publications out in the German language. So in trying to keep abreast with the times I think I understand full well chemical technical and chemical literature.

I identify a sheet of paper shown me as that on which I wrote down an off hand translation of a passage in a photographed print from a periodical.

Plaintiff's Exhibit 38, Gans Article of April 15, 1909, is a photographic reprint exactly like the one so far as I can see from which that translation was made.

The manuscript translation is offered in evidence as "Complainant's Exhibit 42 Manuscript Translation by O. Luthy."

This translation complainant's Exhibit 42 has the date of July 6, 1922. That date was put upon that manuscript on that day, upon July 6, 1922, by myself.

A gentleman, a lawyer, Mr. Rice, who is a frequent caller at the laboratories on business, asked me to translate a passage in a photographic print he had in hand of this Permutite process. I translated it for him then and there at short notice without any particular care.

CROSS-EXAMINATION BY MR. WARDEN:

Mr. Rice told me that he was not well enough versed in German and that those to whom he had shown the paper before differed in the translation. He did not tell me in what way the others to whom he had shown the paper differed in the translation. I have not seen and do not know of any translation of these two paragraphs which are different than the one I have given.

x-Q. 12. Let me read to you a translation of these two paragraphs that have been made by Dr. Francis P. Mason:

> "The apparatus consists of an iron or wooden filter, the height of the permutit bed is determined by the hardness of the specific water and the rapidity of filtration. The useful effect is greater the more slowly the water flows through the permutit filter and the finer the grain of the permutit used.
>
> "The permutit bed lies upon fine sand, which becomes coarser at the bottom. At the top it is best closed off by a sand filter placed about one-third to one-half metre above the surface of the permutit layer. The sand filter under many conditions can be replaced by a limestone filter, for instance, when treating water containing iron and acids. This arrangement of the upper sand or limestone filter will also prevent that by backwashings, the specifically lighter permutits are not mechanically washed away."

Please examine the German text from which you made the translation of Complainant's Exhibit 42 and state wherein the translation made by Dr. Mason that I have just read to you is incorrect, if you conclude that you do not agree with it?

A. The doctor translates here "nach oben hin" he calls it "at the top". I translate it "towards the top". The German word is "nach oben hin" in the direction to the surface of the permutit stratum. I see that don't. I may say that in the absence of diagrams or drawings it is hard to define what the

meanings of this is. I take it however as an experienced technicist to mean that the filter is constructed as stated here by a layer of sand coarser and coarser toward the bottom upon which rests a stratum of permutite. This permutite in my understanding of this writing is covered directly in a sandwich like manner by a second layer of sand which would become in the reverse order coarser toward the top. That is the only way I can construe this writing.

I have constructed in my practical life many filters, somewhat similar but without permutite. Permutite wasn't known that time. I certainly have some experience in the matter. I may especially refer to large filter beds which we used for filtering alumina, which is a pretty hard job. I do not criticise Dr. Mason's translation because it describes filter construction that I might not be familiar with and that I might not consider to be technically good construction. I have no right to criticise Dr. Mason. I translate it the way I understand it; he may have a different understanding. As a matter of translation of German as to whether Dr. Mason's translation is incorrect, I should say that the passage "The sand filter is placed about ⅓ to ½ meter above the surface" is not as I view the matter. Because the original says "towards the top" "nach oben hin" and not "at the top". It ought to be "toward the top".

x-Q. 16. Taking your conception of "nach oben hin", wouldn't you say that that means "towards the top of the apparatus"?

A. That is just what the translation—well, he talks here about the filter, the permutite layer rests on a layer of sand and towards the top it is best closed or finished by a ¼ to ½ meter in height of sand filter.

x-Q. 17. Now, you say, that "nach oben hin" relates to the permutit layer?

A. Which I regard to be sandwiched between two layers of sand a bottom and top layer.

x-Q. 18. That does not answer the x-Q. 17. Do you say that the words "nach oben hin" refer to the permutit layer?

A. That's what I do, that's what I understand. It belongs to the filter. I understand that the permutite stratum is interposed between bottom layer and the top layer. The top layer in my estimation is intended to retain coarse impurities of the water, so as to protect the permutite layer against contamination.

x-Q. 19. Well, that top layer could protect the permutite layer against contamination if it were ⅓ to ½ layer above the surface of the permutit layer, could it not?

A. You mean to say that the top sand layer is a separate filter? Is that what you mean, a separate filter with an air space of one third to one half of a meter between? Is that what you mean?

x-Q. 20. That is what I construe Dr. Mason's translation to set forth and my question makes that assumption. Now, then, with the upper sand layer one-third to one-half meter above the surface of the permutit layer, with an air space in between as you suggest——

A. I don't suggest it, I question it.

x-Q. 21.—would not that upper sand filter protect the permutit layer against contamination?

A. If there were a separate filter for the water to purify the water before it runs on the permutite as a matter of course the permutite would be so much protected.

x-Q. 22. In just the same fashion as it would protect those permutites if that upper filter or layer of sand were resting immediately upon the permutit?

A. That is a great question, because in that case the loose permutite might be continually disturbed, not being held in position.

x-Q. 23. In which case?

A. In the case it was a separate filter on top.

x-Q. 24. State to us a little more fully just what you mean by the permutits being disturbed.

A. Not having had any actual experience with permutit I don't like to make any statement at all.

x-Q. 25. Have you never seen a photograph or a drawing of a zeolite water softener, in which the permutit layer was sandwiched between two beds of sand?

A. No.

x-Q. 27. Have you ever seen a photograph or drawing of a water softening apparatus in which an upper sand filter was shown placed or positioned above the surface of the permutit layer with an intervening or air space between the zeolite layer and the upper sand layer?

A. No; I didn't.

x-Q. 28. Did you ever hear of such a filter?

A. Literature about water softening is very large and there are hundreds of patents taken out. I could not say in an offhand way that superposed filters ever came to my notice or not. It is now about fifty years since water softening for boiler feed purposes came under my superintendence, and that is long before permutite was known. I am inclined not to answer quite

tions because this is a matter of business for myself. My experience in filtering is worth something.

Referring to the German word "angebracht" it can be correctly translated as "placed". You can translate it in a great many ways. Angebracht is from anbringen to bring to, to fetch to, so it can be translated a great many ways.

x-Q. 30. The question is can it not be translated correctly as "placed" as Dr. Mason has so translated it?

A. I can't say that it is incorrect; I would say that in common parlance it would be "fixed". I should like to continue that answer. Much depends whether you speak of a separate filter or a section of a filter or whether you consider it as a layer of sand as I do.

In translating this German sentence much depends on whether you consider that as a separate filter or as a layer of sand. I don't consider it to be a layer of sand above so many inches from the permutite layer. I consider it a layer of sand of from ⅓ to one-half meter in thickness.

x-Q. 33. Yes; but Dr. Mason's translation does not so consider it and what I am asking you to do is to point out wherein Dr. Mason's translation is incorrect?

A. Yes; I have stated it above, I have stated it before. Now, it says here, as I understand it. The permutits layer, the permutite stratum lays upon fine and etc. sand. "Nach oben hin" towards the top, it is best closed, as I call it, shut off, finished, by a sand filter, which to a depth, to a height of one-third to—It says here "Höhe Höhe,—is not depth above the surface of the Permutite stratum. It always refers to that stratum of permutite. I can't make it anything else.

x-Q. 34. The German text says, does it not, that the permutit layer "lagert auf" sand; doesn't it?

A. Yes, lays upon sand.

x-Q. 35. You have translated "auf" upon, haven't you?

A. Yes.

x-Q. 36. Now, I call your particular attention to the fact that in speaking of the upper layer of sand he does not use the word "auf" does he in describing its position with respect to the Permutit layer?

A. He uses the word over, über. It ought to be translated above the surface of the permutite layer.

x-Q. 37. Now, in view of that distinction in the German words employed, is there not foundation for Dr. Mason's translation that this upper layer of sand does not rest upon "auf", but above "über", in distance one-third to one-half meter.

A. That is just what he. That is just what the description

of the filter is not clear. But why is it that he immediately after it talks of that sand filter which under circumstances could be better substituted by lime stone filter without referring in any way to the top layer. And the arrangement of the upper layer of sand or limestone filter shall further prevent the backwashing of the permutit. I can't understand why this could be prevented if it wasn't locked in by a layer of sand.

x-Q. 38. In connection with your translation of this article and preparation for your testimony, was the expression "locked in" or "locked beds" used?

A. I don't remember that, that would be the literal translation of abschliessen (Abschluss). Abschliessen is derived from Abschluss.

There is a difference between the word "abschliessen" and "einschliessen". If you put a prisoner into a cell, he is locked in, eingeschlossen, but a lock wird abgeschlossen, the door is locked off.

NEW YORK, July 19, 1922

CARL V. BERTSCHE, a witness for plaintiff, testifies:

My name is Carl V. Bertsche; age, 41; residence, 1221 Church St., Richmond Hill, L. I.; and occupation, translator.

I had six years high school in Germany, during which six years in chemistry and five years in English. Furthermore, I passed an examination in Germany as druggist, obtained the best marks of all the pupils examined. It is not necessary to mention that I went to New York City College for about one-half year. Since the last twelve years I am a translator by profession. I have a translation bureau; I have been manager of this bureau for the last twelve years, too.

Referring to Plaintiff's Exhibit 38, Gans Article of April 15, 1909, and particularly page 199, the two sentences in the fifth full paragraph in the right hand column, commencing "Die Permutitschicht" and ending "angebracht ist," I translate the German text in these two sentences as follows:

> "The permutite layer rests on fine sand becoming gradually coarser toward the bottom. At the top (upwards) it is most suitably closed by a sand filter, which at a depth of about ⅓ to ½ meter is placed over the surface of the permutite layer."

Referring to a carbon copy purporting to be an affidavit by one C. V. Bertsche with typewritten signature and typewrit-

ten certificate and signature of the notary, that is a copy of the original affidavit which I executed for use in this suit.

Copy of affidavit offered in evidence and marked "Plaintiff's Exhibit 43, Copy of Bertsche Affidavit."

Q. 9. Will you please state the circumstances under which you first saw the Gans Article in German text, and particularly, the part which you translated from Plaintiff's Exhibit 38 into the record in answer to Q. 5?

A. I don't remember exactly. I think about two months ago a Mr. Regen asked me to translate the part in question.

Q. 10. Who is Mr. Regen?

A. He is also a translator.

Q. 11. Can you give his full name?

A. As far as I know it is Bernard Regen.

Q. 12. Please state as near as you can remember the conversation between Mr. Regen and yourself at the time when he asked you to make this translation.

A. I can't remember, as I sometimes translate matters for 30 to 40 different clients during a day. To the best of my recollection he stated that he was making an affidavit or a certified translation respectively of the passage and wanted a translation from some other party.

Q. 13. Do you know whether or not Mr. Regen said that he was making a certified translation of the passage which he asked you to translate?

By Mr. Knight: Question objected to as already answered.

A. I cannot possibly remember.

CROSS-EXAMINATION BY MR. KNIGHT:

x-Q. 14. How do you translate the word "Höhe" in the Gans Article about which you are asked on direct-examination.

A. Depth.

x-Q. 15. What is the little red book you used during direct-examination?

A. A German English Dictionary for Chemists by Austin M. Patterson, Ph.D., Formerly Editor of "Chemical Abstracts."

x-Q. 16. In your affidavit "Plaintiff's Exhibit 43", you state that you are "a professional translator of the German and English languages, *knowing both equally well.*" I ask you to translate the following sentence:

"Uber den Permutiten in Höhe von 30 bis 70 cm ist eine Schutzsicht aus Sand oder Kalkstein gegan Abschlämmung und zur Entsauerung des Wassers angebracht."

And in all the tests of your skill, you may, of course, use paper and pencil to write out your translation in advance of giving your answer and if you want any German dictionaries we will furnish you anything available.

A. "Over the p mutites there is placed a protective layer of sand or limestone, of a thickness of 30 to 70 centimeters, to prevent washing (levigation) and for the deacidification of the water."

x-Q. 17. Please translate into German the following sentence:

"It is best that on its upper surface it be bounded by a sand filter which is placed over said upper surface of the layer of permutit in a depth of from ⅓ to ½ meter."

A. "Am besten wird es an seiner Oberfläche durch ein Sandfilter abgeschlossen, welches ueber der genannten Oberflaeche der Permutitschicht angebracht ist, in einer Hoehe von ⅓ bis ½ meter."

x-Q. 18. From Plaintiff's Exhibit 38, page 199, column at the right, sixth full paragraph, please translate the two sentences beginning with "Hierfür sind", and ending with "hoher Schicht".

A. "For this purpose there are built in 2 filters each having a height of 2.4 meters and a diameter of 1.2 meters. Each filter contains about 700 kilos of dry-centrifugated (450 to 500 kilos air dry) permutite in a layer about 70 centimeters thick."

x-Q. 19. In your translation of the German text, in your answer to x-Q. 18, you translated the German word "Höhe" as "height" while in your translation of the German text in your answer to Q. 5, you translated the same word as "depth". Why do you do this?

A. There is no absolutely equivalent translation for this word into English. It can be translated as height, depth, strength and thickness.

x-Q. 20. Please translate into German the following sentence:

"Toward the top it is best closed off by a sand filter placed at a height of about ⅓ to ½ meter above the surface of the permutit layer."

A. "Nach oben hin ist es am besten durch ein Sandfilter abgeschlossen, welches in einer Hoehe von ⅓ bis ½ Meter ueber der Oberflaeche der Permutitschicht angebracht ist."

ALFRED MUELLER, a witness for plaintiff, testifies:

My name is Alfred Mueller; age 53; I reside in Stamford, Conn.; occupation patent attorney, at No. 565 Fifth Ave., New York City, N. Y.

I was educated in Germany and studied at the Universities of Bonn, Berlin, and Munich, all in Germany. At the latter University, I received the degree of Doctor de Staatswissenschaften after having submitted a treatise on the development of the patent law and its protection in Germany. Then I practiced patent law for two years in Dusseldorf, when in 1899 I came to this country where I continued the practice of patent law making many translations from German patent specifications and publications into English.

I am the same Alfred Mueller who has heretofore testified in this suit, and have made an affidavit for use in connection with this suit. The typewritten instrument comprising three pages handed me I identify as the affidavit referred to which I executed.

It is stipulated by and between counsel that the copy of an affidavit identified by the witness is a correct copy of an affidavit used in this cause by Mr. Rice on May 15, 1922, and the original of which is believed to be on file with the papers in this case.

The affidavit is offered in evidence and marked "Plaintiff's Exhibit No. 44 Copy of Mueller Affidavit."

The translation in my affidavit Plaintiff's Exhibit 44 is a translation of the fifth paragraph in the right hand column of page 199 of Plaintiff's Exhibit 38, beginning with the words "Die Permutitschicht" and ending with the words "abgeschlämmt werden.' The translation made by me and appearing in the affidavit is on page 2, and begins with line 21.

The manuscript in pencil shown me is an original translation written by me in pencil of the paragraph above referred to. The body of the translation is in my own handwriting. I do not know who wrote the name Dr. Mueller at the bottom of this. The writing enclosed in lines at the bottom of the translation is not my handwriting.

The sheet of manuscript in pencil is offered in evidence and marked "Plaintiff's Exhibit 45."

Referring to this manuscript translation Plaintiff's Exhibit 45, I did not write the word in the left hand column in parentheses and make the line drawn vertically at the side of the same.

I cannot remember exactly the time when I made this translation. It was made at the office of Mr. Rice while he had a conversation with some one else. He had asked me to write down a translation of the paragraph of a German publication which he had shown me, and I wrote out the translation in pencil while he was talking to the other party.

Referring to Plaintiff's Exhibit 38, and particularly the fifth full paragraph in the right hand column, the word "abgeschlossen" refers to "Die Permutitschicht." The words "nach oben hin" in the same sentence containing the word "abgeschlossen" also refer to "Die Permutitschicht" meaning that the permutit layer is terminated towards or at the top by a sand filter.

CROSS EXAMINATION BY MR. KNIGHT:

In the last eight or ten years I have not done any work either for Mr. Rice personally or for the firm of Philipp, Sawyer, Rice & Kennedy, as Patent Attorney, or otherwise.

I have not testified for clients of theirs as an expert witness during that time except in this same suit. On the day when I made the first translation, which has been identified as "Plaintiff's Exhibit 45", Mr. Rice showed me a photostat copy of the publication from which this translation was made, calling my special attention to the paragraphs referred to on page 199, and asking me to make a translation of the fifth paragraph. I wrote the translation out in pencil while he was talking to another party. Before the other party came in and before I wrote off Plaintiff's Exhibit 45, I did not read off the translation into English to Mr. Rice offhand. As I remember when I entered Mr. Rice's office the party referred to was already there. I don't remember the name.

x-Q. 25. Would you remember the name if you heard it?

A. I think I would.

x-Q. 26. Do you know him?

A. No.

x-Q. 27. Was the name Kriegsheim?

A. Yes.

Referring to what I can remember of the conversation between Mr. Rice, Mr. Kriegsheim, and myself, on that occasion, after I had been introduced to Mr. Kriegsheim by Mr. Rice, Mr. Rice showed me the photostat copy of a German publication containing an article relating to permutits by Dr. Gans. He told me that there had been some discussion about the translation of this article and he called my special attention to page

199 and asked me whether I could translate offhand paragraph 5 in the right hand column. He handed me a pad of yellow writing paper and while he was continuing his conversation with Mr. Kriegsheim I wrote a translation of the paragraph referred to in pencil. At the time Mr. Rice and Mr. Kriegsheim were talking about this translation. After I had made my translation, according to my memory, Mr. Rice then showed me a translation of the same article made by Dr. Mason and asked me whether he had correctly translated the particular paragraph. I told him that in my opinion the reference to the word "Höhe" had not been correctly translated by Dr. Mason. Mr. Kriegsheim was also of my opinion.

x-Q. 34. Well, what did he say about it?

A. I do not remember the exact words of the conversation, and of what Mr. Kriegsheim stated, but I remember that we agreed on the translation of that particular portion of the article by Dr. Mason not being a correct translation.

x-Q. 35. Well, did you discuss the meaning of any other words with Mr. Kriegsheim?

A. We also discussed the meaning of the word "abgeschlossen."

x-Q. 36. What did Mr. Kriegsheim say about that?

A. Mr. Kriegsheim I believe thought that "closed off" was perhaps the correct translation, if I remember correctly.

x-Q. 37. Did you agree with him?

A. I myself preferred the word "terminated."

x-Q. 38. I show you "Plaintiff's Exhibit 45" and show you the portion immediately before the word "terminated" and ask you if something has not been erased therefrom?

A. The word "preferably" has been erased.

x-Q. 39. What has been written in its place and who wrote it there?

A. The word "best" was written in its place. I believe Mr. Rice wrote it.

x-Q. 40. At any rate, it isn't in your handwriting.

A. No.

x-Q. 41. Now, in the third line of this "Plaintiff's Exhibit 45" the word "towards" has been scratched out and "at" written above it; it that right?

A. Yes.

x-Q. 42. Who made that change?

A. Mr. Rice, I believe.

x-Q. 43. At any rate, you didn't make it, is that correct?

A. Yes.

x-Q. 44. You mean to say that you did not erase "towards" and insert "at."

A. Yes.

x-Q. 45. Now again calling your attention to Plaintiff's Exhibit 45, did Mr. Rice draw the verticle line at the left side and write the word (depth) beside it?

A. No.

x-Q. 46. Who did?

A. I don't know.

x-Q. 47. Did you leave this paper Plaintiff's Exhibit 45 with Mr. Rice and Mr. Kriegsheim when you left Mr. Rice's office that day that you wrote it?

A. Yes, I left it on Mr. Rice's desk.

x-Q. 48. Was the word (depth) and the line on the paper when you left it that day?

A. Not to my recollection.

x-Q. 49. Who wrote the words enclosed in parentheses and between lines just below the body of the writing on "Plaintiff's Exhibit 45."

A. I believe Mr. Rice did but I am not sure.

x-Q. 50. Who put the carat after filter in the fifth line of Plaintiff's Exhibit 45, and drew the lines around portions of what you have written which indicated a change of position desired in parts of your translation?

A. I believe I did myself.

x-Q. 51. Please state whether the carat is made with the same kind of pencil that wrote the words "at" and "best" or not?

A. I can't tell.

x-Q. 52. Does it look like it was made with the same pencil as that with which you wrote the word "filter" immediately preceding it?

A. It may have been with the same pencil for I asked Mr. Rice for his pencil to make this correction?

x-Q. 53. Oh, then, this correction involving the change of position of part of your translation was not made until after you had begun discussion of your translation with Mr. Rice and Mr. Kriegsheim; is that correct?

A. No; after I had made the translation I read it over and suggested that it would be better to make this correction.

x-Q. 54. Read it over to whom?

A. While I was reading it to Mr. Rice.

x-Q. 55. Please answer the preceding question?

A. There was no discussion about my translation until after I had read the translation over with Mr. Rice.

x-Q. 56. Well, do you mean that he stood beside you and read it over your shoulder?

A. No, Mr. Rice was sitting at his desk and I had been writing the translation on a corner of his desk while he was talking to Mr. Kriegsheim.

x-Q. 57. Were you on the same side of the desk as Mr. Rice while you are writing the translation?

A. No, I was sitting at an angle, almost at right angles to Mr. Rice.

x-Q. 58. Isn't it a fact that Mr. Rice's desk is a roll top desk?

A. I don't remember; it seems to me that he was sitting in front of a table.

x-Q. 59. Then he wasn't sitting at his desk at all; is that right?

A. Perhaps it was.

x-Q. 60. He was sitting in a room in the suite of offices in which we are now taking testimony; was he not?"

A. Yes.

x-Q. 61. Will you please go into that room with opposing counsel notary and myself, look at the furniture therein and if your recollection is clear about it after doing so, straighten out the position of parties on this record so that the court will clearly understand the situation?

A. Yes, with pleasure.

Counsel for plaintiff enters on the record the fact that the notary, and counsel for both parties went into Mr. Rice's office with the witness; that at request of Mr. Knight a ruler was produced, the witness was directed to measure Mr. Rice's desk or table both in length and in width and then take the measurement from one leg of this desk or table to the opposite wall these measurements being made by the witness and carefully taken down on a piece of paper by the notary, whereupon all parties returned to the examination room.

x-Q. 62. Did you find the furniture in Mr. Rice's room as you recollect it was on the day you wrote Plaintiff's Exhibit 45.

A. As I recollect it there was another chair in the room near the desk.

x-Q. 63. What sort of desk is it that Mr. Rice and yourself were sitting at when you wrote Plaintiff's Exhibit 45?

A. It is a flat top desk which at that time appeared to me like a large table.

x-Q. 64. Is the back of the desk up against the wall?

A. Yes.

x-Q. 65. Was Mr. Rice sitting in the swiveled arm chair in front of the desk when you were writing Plaintiff's Exhibit 45?

A. According to my recollection, he was sitting in the arm chair.

x-Q. 66. Were you sitting at the end of the desk at Mr. Rice's right, when you wrote Plaintiff's Exhibit 45?

A. Yes, I was.

x-Q. 67. How long and how wide is the desk?

A. My measurement of the desk made in your presence showed that the length of the desk is about 64 inches and the width about 34 inches.

x-Q. 68. Mr. Rice's room is in the general shape of a piece of pie, isn't it?

A. I paid little attention to the shape of the room, except that I noted that it is tapering.

x-Q. 69. What is the distance from the corner of the desk next to Mr. Rice and yourself on that occasion and the wall behind Mr. Rice when sitting at the desk?

A. At the point where the wall nearest approaches the corner of the desk the distance between that corner and the wall as my measurement in your presence has shown is about five feet.

x-Q. 70. Who was sitting in the other chair mentioned in your answer to x-Q. 62 on that occasion?

A. If you mean the additional chair which at that time I believe was in the room, it was occupied by myself.

x-Q. 71. Was Mr. Kriegsheim standing up or sitting down when you wrote Plaintiff's Exhibit 45?

A. Mr. Kriegsheim was leaning against the head of the couch.

x-Q. 72. And the head of the couch was on the same wall that the desk backed up against and right snug up to the chair in which you were sitting, was it not?

A. The chair I was sitting in was standing against the corner of the desk or table.

x-Q. 73. Then Mr. Kriegsheim was in position to look over your shoulder while you were writing Plaintiff's Exhibit 45, was he not?

A. I can't tell because I paid no attention to Mr. Kriegsheim when I wrote the translation.

x-Q. 74. Please go into Mr. Rice's office and measure the distance between the head of the couch and the end of Mr. Rice's desk on which you wrote "Plaintiff's Exhibit 45?"

The witness accompanied by counsel for the opposing parties proceeded into Mr. Rice's room where the witness was provided with a ruler and proceeded to make two measurements one on an angle from the corner of the desk to the nearest part of the lounge in accordance with the directions of Mr. Knight, and a second measurement directly across at right angles from the end of the desk to the couch which measurements were duly reported to Mr. Knight in the presence of Mr. Warden and Mr. Massie.

x-Q. 75. What is the distance from the corner of the desk we have been speaking about to the end of the head of the couch you testified about?

A. The distance is 28 inches; for the distance between the desk and the head of the couch on a straight line it measured exactly 26 inches.

x-Q. 76. When we were in the room just now there was a chair between the end of the desk and the lounge occupying practically all the space with its back to the wall, is that the position the chair was in when you were sitting in it writing Plaintiff's Exhibit 45?

A. I was not sitting in that chair. I was sitting in another chair facing the corner of the desk.

x-Q. 77. Then you were sitting in a chair with the corner of the desk between your knees while you were writing Plaintiff's Exhibit 45, is that correct?

A. I was not sitting very close to the desk, but I was sitting facing the corner of the desk.

x-Q. 78. Is it not a fact that Mr. Kreigsheim on your right and Mr. Rice on your left, while you were writing Plaintiff's Exhibit 45 were in position where they could readily see what you were writing, if they wanted to?

A. It would have been difficult for Mr. Rice as the pad on which I was writing was turned towards him head up and half of my back was turned toward Mr. Kriegsheim who at the time had some papers in his hand about which he evidently was talking to Mr. Rice.

x-Q. 79. In your answer to x-Q. 52, you said you "asked Mr. Rice for his pencil", what happened to yours?

A. After I had written the translation I had put the pencil back in my pocket. It was a pencil in a silver pencil holder.

x-Q. 80. How did you come to make the lines indicating change of position of certain parts of your translation after you had read it aloud to Mr. Rice and Mr. Kreigsheim in other words, what did they say that caused you to make the change?

A. As I was reading the translation over with Mr. Rice it occurred to myself that it would be better to change the position of the words referred to.

x-Q. 81. Please read the sentence in which the three or four changes were made just as you originally wrote it

> "towards the top it is preferably terminated by a sand filter which is arranged above the surface of the layer of permutit having a height of about ⅓ to ½ meters."

x-Q. 82. Has something been erased from the end of the sixth line just after the word "permutit"?

A. No.

x-Q. Now, please read the same sentence after it had been changed to suit everybody at this meeting?

A. "At the top it is best terminated by a sand filter having a height of about one-third to one-half meter which is arranged above the surface of the layer of permutit."

It is not apparent to me that one pencil was used in making the encircling lines around the words in lines 7 and 8 and another in making the carat after the word "filter". If I remember correctly I was in the room with Mr. Rice and Mr. Kriegsheim on the day when I wrote out Plaintiff's Exhibit 45 about half an hour. I had never seen the article before that day, nor have I talked with any one about it. Mr. Rice called me up on the telephone asking me whether I could come down to his office. I believe he said that it was a matter of a translation from a German publication.

After that day it was a few days later that I saw Mr. Rice again at his office, when I went there. I believe it was to execute an affidavit regarding this matter. I was there about three quarters of an hour, I think. I believe at that time only Miss White, now acting as notary and typist in the taking of my deposition, was in the office outside of Mr. Rice and myself. Mr. Rice and myself again discussed the translation of that particular portion of the article by Dr. Gans and Mr. Rice suggested that I make an affidavit embodying the translation made by Dr. Mason and the one made by myself; at the same time stating my qualifications. I believe that Dr. Mason's translation had been shown to me at the occasion of my first visit. Possibly Mr. Kriegsheim had it in his hand on that first visit; I don't know. I don't know that the Mason translation constituted "the papers" which I testified previously Mr. Kriegsheim had in his hand when he was standing next to my chair while I was writing out Plaintiff's Exhibit 45. Mr. Rice

showed me the Mason translation on the occasion of my first visit. It is not according to my recollection that the changes were made by him in my translation Plaintiff's Exhibit 45 after I had discussed Dr. Mason's translation.

I translate from English into German:

"The permutit-bed lies upon fine sand, which becomes coarser at the bottom. At the top it is best closed off by a sand filter placed at a height of about ⅓ to ½ meter above the surface of the Permutit layer" as follows:

"Das Permutitbett ruht auf feinem Sand, der nach dem Boden hin gröber wird. Oben wird es am besten von einem Sandfilter abgeschlossen, das in einer Höhe von ungefähr ⅓ bis ½ Meter über der Oberfläche der Permutitschicht gelegen ist."

The German word "Höhe" literally translated means height. But it can also mean depth, because Höhe is sometimes used synonymously with "Tiefe". I translate the following sentence:

"Ueber den Permutiten in Höhe von 30 bis 70 cm ist eine Schutzschicht aus Sand oder Kalkstein gegen Abschlämmung und zur Entsauerung des Wassers angebracht",

as follows:

"Above the permutits a protecting layer of sand or limestone having a height of 30 to 70 cm is provided against flushing and for the deacidizing of the water."

I translate the following sentence:

"Die höchste zulässige Höhe in welcher das Barometer angebracht werden kann, ohne Korrektur, ist eine Höhe von zirka 100 meter über der Oberfläche des Meeres, wo die Höhe der Quecksilver Säule des Instrumentes circa 760 mm. beträgt",

as follows:

"The greatest permissible height at which a barometer can be placed without correction is a height of about 100 meters above the surface of the sea where the height of the mercury column of the instrument is about 760 mm."

REDIRECT EXAMINATION:

I said that the word "best" which appears before "terminated" in Plaintiff's Exhibit 45, was written by Mr. Rice, and in answer to x-Q. 38, I stated that the word "preferably" had been erased before "terminated". Mr. Rice asked me whether the word "best" wasn't better than the word "preferably", and I told Mr. Rice that I agreed with him.

Still referring to Plaintiff's Exhibit 45, I stated that the word "towards" had been stricken out and "at" written above it, and that I stated that Mr. Rice made that change. The suggested change was made by Mr. Rice and the change was made with my consent.

I read into the record my translation omitting Mr. Rice's changes and including only the changes which I personally made in the translation as follows:

> "The layer of permutit rests upon fine sand becoming coarser towards the bottom. Towards the top it is preferably terminated by a sand filter having a height of about one-third to one-half meters which is arranged above the surface of the layer of permutit. The sand filter is under certain circumstances better replaced by a limestone filter, *e. g.* in connection with iron-containing and acid waters. These arrangement of the upper sand or lime-stone filter shall moreover prevent that at back-washes the specifically light permutits are mechanically flushed away."

According to my knowledge of technical and scientific German and English, it was a fair translation, but the word "These" before "arrangement" should be, of course, "This".

Rd-Q. 110. State whether or not the translation as you have just given it, is the result of your own uninfluenced views or as a result of the suggestions of Mr. Rice, Mr. Kriegsheim, or anyone else.

A. The translation was made by me of this part independent of any suggestion from any one.

I did not consider the suggestions as to the change of "towards" to "at", and "preferably" to "best" as in any way altering my views as to the meaning of the part commencing with the word "terminated" and continuing to the end of my translation which is the word "away". I did not consider these changes at all essential which is the reason that I readily consented to them being made. I stated that Mr. Kriegsheim thought that the word "abgeschlossen" should be translated

by "closed off", and I preferred the word "terminated". I am still of the opinion that the word "terminated" is the more accurate translation of the word "abgeschlossen" in the particular paragraph in "Complainant's Exhibit 38" to which my translation relates, than would be the word "closed off."

Rd-Q. 113. Supposing that in the cramped quarters of Mr. Rice's room, both Mr. Kriegsheim and Mr. Rice had stood up and looked over your shoulder when you were writing out the translation Complainant's Exhibit 45, would that in any way have affected or influenced your translation of the particular paragraph in "Complainant's Exhibit 38" which you translated?

By Mr. Knight: Question is objected to as improper redirect-examination and also because it is not asking for testimony as to any fact but for a statement of his opinion as to what he would have done had a certain supposed condition existed.

A. No. Because when I was writing the translation I was entirely oblivious of the presence of anyone else in the room.

By Mr. Knight: The whole answer is objected to and particularly everything after the word "No", because it is volunteered.

Rd-Q. 114. Did you adopt Mr. Rice's changes of "towards" to "at" and "preferably" to "best", as satisfactory to yourself or not?

A. I adopted Mr. Rice's changes or suggestions because I did not consider them as relating to anything particularly essential.

Rd-Q. 115. In your answer to x-Q. 102, you stated that the German word "Höhe" literally translated means "height", but that it can also mean "depth". Are there any other meanings which may be given to it when translated into English than "height" and "depth".

A. In certain connections, it might also be translated by the word "distance". I cannot think of any other meaning that could be given to the German word "Höhe" translated into English.

Recross Examination by Mr. Knight:

I did not change my translation to suit Mr. Rice because I though he was a better German scholar than I was or because

he was my employer in this matter, and I would like to make my service satisfactory.

If I wanted to describe in German the depth of a well, I would use the word "Tiefe" not "Hoehe".

The English equivalents given in Adler's German and English Dictionary on page 294 for the word "Höhe" are "height", "highness", altitude, elevation, loftiness, compass, and rank. There is no definition in this book for "Höhe" meaning depth.

I find in Adler's Dictionary the definitions for "Tiefe" as depth, deepness, profoundness, profundity.

Rx-Q. 122. Please produce your authority for your translation of Höhe, by the word "depth".

A. I believe that I stated that the German word "Höhe" was at times synonymously used with the word "Tiefe" which entirely depends upon the conditions or circumstances under which the word "Höhe" is used.

By Mr. Knight: The foregoing answer is objected to as evasive and volunteered.

Rx-Q. 123. Please answer Rx-Q. 122?

A. I do not understand what kind of evidence you are calling for.

Rx-Q. 124. I mean a German dictionary or book by whatever name you call it that gives definitions of these German words, "Höhe" and "Tiefe"?

A. Of course I have no dictionaries with me to prove the correctness of my statement, but from my experience as a translator, especially a translator of technical and scientific papers, I can say that a literal translation made only with the help of a dictionary very often proves an entirely wrong and misleading translation.

Rx-Q. 125. What is the German word for "thickness"?

A. "Thickness" can be translated either as "Dicke", "Starke" or "Durchmesser".

NEW YORK, July 20, 1922, 10 A. M.

REDIRECT BY MR. MASSIE:

Adler's Dictionary is a dictionary of the German and English languages in two parts of the year 1888, and is to all appearances not a full and complete unabridged dictionary.

In a book shown me entitled "Technological Dictionary" by Gustav Eger, published by Frederick Vieweg & Son, Brunswick, 1884, the definition therein under Höhe where Höhe is

used in the sentence "Höhe des Schriftkegels" reads "depth of the body".

Rd-Q. 128. In a book shown me entitled Illustrated Technical Dictionary in six languages, English, German, French, Russian, Italian, Spanish by Alfred Schlomann, Engineer, Vol. 5, Railway Construction and Operation, Published New York, McGraw Publishing Co., 1909, and referring to pages 103, 112, 158, the German words at the place marked on page 103 are "Bettungshöhe" and "Bettungsstärke" and their English definitions are given as "Depth or thickness of ballast". At the place marked on page 112, the German word is "Schienenhöhe", and the English definition of this word is given as "Depth of the rail". At the place marked on page 158, the German word is "Stopfhöhe", and the English definition of this word is given as "Depth of packing or tamping".

I could easily ascertain the name or names of any other dictionaries or books of authority which would show the word Höhe translated as depth and furnish the names of the same to the notary before tomorrow evening.

Rx-Q. BY MR. KNIGHT:

When I was answering I didn't read and translate the word printed immediately after "Schriftkegels" because I had been asked only to read the definition of the word "Höhe", which I did. The word appearing in parentheses is an abbreviation of the German word "(Buchdruckerei)", which means "Book-printing", or book printing art.

The word "Schriftkegels" is a technical term used in printer's art, but this does not mean that the word "Höhe" is a particular technical term used only in the printer's art.

Looking at this same book, Technical Dictionary of Gustav Eger, page 721, on the page referred to appears the word "Schrifthöhe" the definition of which word is given as "height of letters or types". I didn't answer yes because your previous question asked whether "Schrifthöhe" did not mean "height of letters of type". The dictionary gives this only as a definition. "Schrifthöhe" is given in this dictionary as a printer's term. On the same page of this book "Schriftkegel" is defined as "body, shank, depth of a letter".

Rx-Q. 136. Now, referring to the other book, Illustrated Technical Dictionary in Six languages by August Schlomann, are not the words "Bettungshöhe" on page 103, "Schienenhöhe" on page 112, and "Stopfhöhe" all compound words?

A. Yes.

DR. ALEXANDER GREEN, a witness for plaintiff, testifies:

My name is Alexander Green; I am 34 years of age; I reside at 106 W. 13th St., New York City; my occupation is that of Modern Language Editor at D. C. Heath & Co., New York City.

My early education up to my fifteenth year was obtained in a gymnasium in Hungary where instruction was given in German as well as Hungarian. Since my arrival in the United States in 1903 I have specialized, in the High School, College and University, in Languages, particularly in Germanic philology. I hold the degree of B. A. from the College of the City of New York, and the degrees of M. A. and Ph. D. from Columbia University. Moreover, I have to my credit study at the University of Leipsic, Germany, likewise in Germanic philology. From 1913 to 1916 I was instructor in German at the University of Illinois, where part of my duties consisted in imparting instruction in so-called scientific German, which included instruction in chemical German. From 1916 to 1917 I held the position of Johnston Research Scholar in Germanic philology at Johns Hopkins University. During the late war I held for two years the positions, successively, of a supervisory translator for German in the Bureau of Investigation, U. S. Department of Justice, and of the head of the Uncommon Languages Department of the U. S. Executive Postal Censorship. During the war, also, I made translations of articles and books for the Red Cross Institute of Vocational Reconstruction, and recently translated a series of articles from the German and French dealing with the artificial production of synthetic sapphires and rubies. I may add that during my tenancy of an instructorship at the University of Illinois I did considerable work of translation in scientific and chemical German for the Department of Agriculture of said University. All these translations above mentioned I did from the German language into the English language and accordingly I wish to qualify as expert in translating from the German into the English language.

Q. 3. How about your ability to translate from the English into the German?

A. My ability to translate from the English into the German is considerable, though, by reason of lack of opportunity I would not make it as good as my ability to translate from German into English.

D. C. Heath & Co. is a firm dealing with the publication and promotion of educational text books and I am in charge of such

text books as are written for the purposes of school instruction in French, German and Spanish, Italian and Portuguese. My duties consist in making arrangements for manuscripts, criticizing the same, and seeing the same through the print. The latest book upon which I am working from these standpoints is entitled "Greenfield's Technical and Scientific German" which I have had to criticize in the manuscript from the standpoint of correct interpretation to the students.

Referring to Plaintiff's Exhibit 38, Gans Article of April 15, 1909, particularly to page 199, right hand column, full paragraphs four and five, the fourth paragraph beginning "Die Apparatur" and the fifth paragraph terminating with the words "abgeschlämmt werden" I translate as follows:

"The equipment consists of an iron or wooden filter. The thickness of the layer of permutit depends on the degree of hardness of the water in question and the speed of filtration aimed at. The efficiency is the larger the more slowly the water flows through the layer of permutit and the finer grains the permutit possesses.

The layer of permutit rests upon fine sand which becomes coarser towards the bottom. On its upper surface said layer of permutit had best be bounded by a sand filter which is placed, in a thickness of from ⅓ to ½ meter over the surface of the layer of permutit. The sand filter, under certain circumstances, had best be replaced by means of a limestone filter, thus, for instance, in the case of waters containing iron and acids. This arrangement of the upper filter of sand or lime has the added advantage of preventing that, in the case of backwash the specifically light permutits should be mechanically flushed away."

Referring to a copy of a translation made by Dr. Francis P. Mason, one of the witnesses who has heretofore testified for defendants in this case, entitled "Translation made by Dr. Francis P. Mason. Article of Dr. R. Gans in the CHEMISCHE INDUSTRIE, Vol. 32, April 15th, 1909, Pages 197 to 199" and to page 12 of this copy and particularly the second and third full paragraphs commencing "The apparatus consists" and ending "washed away", and comparing Dr. Mason's translation with the original German text, I would say that the translation of the word "Höhe" at the beginning of the second sentence of the first paragraph, by means of the English word "height" is not correct or expressive enough. Furthermore, the expression "Nach oben hin" which begins the second sentence of the second paragraph should not be translated by means of the Eng-

lish expression "At the top," as this is inadequate. Reading this second sentence right after the first, the meaning of the author is quite clear, namely, he wishes to define the lower and upper boundaries of the layer of permutit. He states, in effect, that on its bottom this layer is in contact with sand and on its top it is contact with a sand filter which possesses a thickness of from ⅓ to ½ meter.

It should also be noticed in the second paragraph that while the appearance of the filter apparatus is described in terms of what the German calls real passive, at the end of the second sentence, the expression "angebrecht ist" is not a real passive verb. I conclude from the fact that there is a change from the real passive to the form of a verb which is not a real passive in the second paragraph alluded to by me in the latter that if the intendment of the author had been to state as Dr. Mason's copy—translation—states that the sand filter itself is placed at such and such a distance above the surface of the permutit layer, he would have continued his employment of the real passive and the sentence would have read "über die Oberfläche der Permutitschicht angebracht wird."

As nearly as I can remember I first saw the German text on page 199 of Complainant's Exhibit 38, which I have translated into the record on the 4th of May, 1922. The translation which I have made is the result purely of a casual translation of a text presented to me for the first time at the time of the original translation. By "original translation" I mean the translation which I made on the 4th of May, 1922, when I first saw the copy of the German text in question.

Subsequent to this first or original translation, I had occasion to consult for purposes of comparison, Dr. Mason's translation of the paragraphs in question, and have also seen translations made by other witnesses. Moreover, not content with this, I have in the meantime casually presented the same paragraphs to a number of my acquaintances.

Mr. W. E. Pulsifer, president of D. C. Heath & Co., whose confidence I enjoy, happened to tell me one day in April, 1922, on the occasion of a divergence of opinion we were discussing with respect to a school-book that his friend Mr. Rice had an equally interesting divergence of opinion with respect to the correct translation of a German passage which he had encountered in the course of his law practice. Upon my expressing to Mr. Pulsifer my keen curiosity in the matter, stating I was conversant with the German language to a thoroughgoing extent, a meeting was arranged by Mr. Pulsifer between Mr. Rice and myself. Upon the occasion of this meeting, at the date

above mentioned, Mr. Rice, without any preliminaries or particulars, thrust before me the photostat copy of the German article in question and asked me to translate it, if I can, offhand. This I was able to do after a careful reading of several of the paragraphs before and after the two central paragraphs in question, and I gave to Mr. Rice, as far as I can recollect, this translation which I had made, as is my custom, in ink.

I identify a yellow sheet of paper containing some writing in ink with the word "best" written in pencil in line 2, and the word "abgeschlossen" written in pencil above the line 3, with a carat in pencil before the words "a sand filter" in said line 3, and with the name Dr. Green, written in pencil, at the bottom, and some sort of a drawing in pencil below the ink writing as my first or original translation of the central paragraph of the article in question. However, the four words in pencil have not been written by me. This is the first time that I saw this sketch at the bottom, the paper having apparently been used for scratch purposes. That part of the writing in ink was made by me and comprises my said original translation.

The writing is offered in evidence and marked "Plaintiff's Exhibit 46 Dr. Green's Original Translation".

I consider the translation which I have made of the German text to be a full, fair and correct translation of that particular part of the text and does not differ in any essentials from my first original translation. Whatever further thought I have given to this matter since I made my first original translation has only confirmed me in my first opinions.

I identify a carbon copy comprising three pages of a paper purporting to be an affidavit with a typewritten signature Alexander Green as an affidavit which I executed on the 5th day of May, 1922, with respect to a translation by Dr. Mason of the Gans Article in question.

The copy of affidavit is offered in evidence and marked "Plaintiff's Exhibit No. 47", Copy of Alexander Green Affidavit."

Cross Examination by Mr. Knight:

x-Q. 24. Please translate from English into German:

"Oh, the height and depth of mercy."

A. With the distinct understanding that I have unequivocally qualified as an expert translator from German into Eng-

lish and not from English into German and that I may hereafter refuse to make translations from English into German, I translate "Oh, the height and depth of mercy" into German as follows:

"Oh, uber die Höhe und Tiefe der Barmherzigkeit!"

Referring to my activity as instructor in German at the University of Illinois, this institution is located in the twin cities of Urbana and Champaign in the State of Illinois, about 126 miles due south of Chicago. The work took all my time. I did the work in the school of Liberal Arts and Sciences as well as in the Graduate School of the University of Illinois, where I gave instruction in accordance with the schedule apportioned to me at the beginning of each academic year.

x-Q. 39. What I am trying to find out, doctor, is what was the place of your residence during the time that you were engaged as instructor in German in the University of Illinois?

A. The place of my residence was for a time in Urbana and for another span of time in Champaign, which cities, as I stated before, are twin cities. The places of instruction to which I referred are located in the city of Urbana; the entire plant of the institution extends over part both of Champaign and of Urbana. My employment as instructor at the University of Illinois terminated with the end of the summer session, in August, 1916. My employment as research scholar at Johns Hopkins University extended over the academic year of 1916-1917. Upon the declaration of hostilities with Germany I was released by the President and Senate of Johns Hopkins University in order to serve in the U. S. Department of Justice. In my absence at this war work I had the honor done to me of another year's renomination as Johnston scholar, but on account of continuing activities in the Government service I could not return to resume my position. No numbers were assigned to our division in the U. S. Department of Justice, which was headed by the late Prof. W. A. Hervey of Columbia University and for which I was accepted by Mr. Bielaski of the Bureau of Investigation. My actual connection with the scholarship work at Johns Hopkins University ended May, 1917. From the beginning of the academic year in 1916 until the time in May, 1917, my whole time was taken up with this scholarship work. My work as supervisory translator for German in the Bureau of Investigation, U. S. Department of Justice, began in May, 1917, and ended, to the best of my recollection, in the month of August, 1917. I then took my family to Lake George

for a vacation and after that in the month of October, 1917, I was called to New York, from Lake George, by the U. S. Postal Executive Censorship. This occupation lasted until the end of May, 1919. In that work I was head of the division of Uncommon Languages and had charge, among others, of correspondence and newspapers in the following languages: German, Dutch, and the Scandinavian Languages, as well as all the Romance languages. For the purposes of our division, to which all the incomprehensible or undecipherable German material was sent, German *was* classed as an "Uncommon language". This did not take all my time after the armistice. After the armistice I devoted part of my time, namely, mornings, to the College of the City of New York, where I was instructor in Romance languages.

The use of any language to a certain extent is personal matter as to the style of expression. Obviously, persons of little culture will have a different mode of thinking and a different style of expression from persons of more advanced culture, though they be speaking what is commonly said to be the same language. Highly educated authors do, indeed, often have a style peculiar to themselves, as long as their style moves within the limits of the commonly accepted and understandable grammatical structure of the language. I doubt there is the same latitude of expression in technical writing, although an author may naturally want to make use of synonyms and antonyms in order not to have his style result in monotonousness.

Referring to page 2 of my affidavit, Plaintiff's Exhibit 47, line 9, where I say of Dr. Mason's translation "He has missed the intent of the author", this statement of mine is not to my mind bound up with the style of the author. I considered the two central paragraphs and especially the various sentences of the second paragraph in their relative bearing upon each other. In other words, I considered the context in the sequence of sentences and did not try to give a literal translation of disjointed sentences.

Asked whether "aimed at" is as good a translation of the German words "richtet sich" as "depends upon", I say that "Sich richten" means to be directed towards as well as "depend upon", when the preposition "nach" is used with it. In connection with the passage which counsel had before him, I would not use "aimed at" at all. The German expression "richtet sich nach" was rendered in my translation as "depends on", and the expression "aimed at" was simply an adequate rendering of the last noun in the sentence which from an English standpoint appears all too brief, without some amplification.

x-Q. 59. Please point out the German word or words or part of German word in the text from which you have translated that means "aimed at"?

A. As I implied in my answer to Q. 58, there is no such German word in the text and there is none needed in the German text. I have simply made my English more clear and not at all at the expense of the meaning inherent in the German text.

This is not simply an example of the personal style of expression. I felt and still feel that any translation of the last noun in the sentence which does not make that noun clear would not be adequate. The purpose of the translation is to give a clear and adequate rendering of the original. In translating from one language into another, this point must always be taken into consideration and it is more a matter of judgment than of personal leanings.

Asked whether I mean clear to a philologist or to one skilled in the art to which this article pertains, I would say the latter, while disclaiming in any way to be skilled in the art to which this article pertains. I will now read into the record a translation of the sentence in order to explain my meaning.

"The thickness of the layer of permutit depends on the degree of hardness of the water in question and the speed of filtration."

There can be no sense in the last expression "the speed of filtration" if it is merely descriptive. I would say that the thickness of the layer will have to vary with respect to two factors, *a*, how hard the water is, and *b*, how fast it is desired to filtrate the water, and not as the unmodified translation would imply to some people, the speed at which the water flows through the filter. Judging from this standpoint I consider that the expression "aimed at" is not at all out of place in the translation rendered by me.

x-Q. 63. Is "aimed at" a literal translation of anything in the German text of this Gans article of 1909, Plaintiff's Exhibit 38.

A. It is not.

Asked whether the second word of that sentence "Höhe" would have been just as correctly translated by "height" as by "thickness", I say literally, yes. On the other hand, I have tried to give a translation that would take into account the so-called "genius" both of the German and of the English languages. What the German expresses by means of the word "Höhe", we ordinarily express by means of the word "thick-

ness" as describing the measurement of solid or liquid matter.

I translate into German the sentence "The house is ten meters high", as "Das Haus ist 10 m. hoch."

If the last word of this sentence in English namely, "high", was erased and the words "in height" put in its place the sentence would then be translated into German as "Das Haus ist von einer Höhe von 10 m."

Referring to Plaintiff's Exhibit 38, I translate therefrom, page 199, right hand column, sixth paragraph, second and third sentences:

> "For this purpose there are installed two filters each of a height of 2.4 m and of a diameter of 1.2 m. Each filter contains about 700 kg centrifugally dried permutit (450 to 500 kg dried by air) in a thickness of (pardon me)—in a layer which is about 70 cm in thickness."

I am not experienced in technical matters pertaining to this water softening art.

x-Q. 70. Then how do you reach a conclusion as to what a technical man like Gans, the author of this article "intends" to say?

A. I reached no conclusion as to what a technical man like Gans, the author of this article "intends" to say. I translate adequately what he actually says.

Referring to three translations of a portion of this German text, one contained in my affidavit, one in my original longhand translation as it was before it was altered by Mr. Rice and one in your answer to Q. 5, and being asked which of these three I think is the best exhibition of the translator's art, I would say in looking over the three exhibits presented to me, that I do not consider or accept Mr. Rice's interlinear notes to the first original translation, but consider the translation written in ink as being what I first gave as a translation. Of the three translations I have no preferences whatever since, with the exception of the use of synonyms and antonyms (which I stated in an answer above, were open to a translator as well as to a writer), these three translations are essentially identical. For the sake of this record however, and as a basis of further action I declare the translation which I made today as acceptable.

x-Q. 74. Well, if it is true, as you have just stated, that you do not accept Mr. Rice's interlinear notes, how does it happen that in your affidavit your translation reads "It is best that on its upper surface it be bounded by a sand filter" which is with Mr. Rice's correction instead of "It is to be preferred that on its upper surface it be bounded by a sand filter" which is

the way you wrote it in long hand. I hand you "Plaintiff's Exhibits 46 and 47" for your examination?

A. From my reply to Q. 73, it is obvious that I used the terms "consider", "accept", and "acceptable" as meaning—for the purposes of the present discussion. I seem to have anticipated the counsel in his further intentions but I inferred from his question that he wanted to test me on the *contents* of my translations, and desired to furnish him with *one* translation to which he might confine himself in asking such questions. The interlinear word "best", as a synonym for "to be preferred", was discussed by me in the course of my conversation with Mr. Rice, following my original translation and I suggested it to him that in drawing up the affidavit he might make use of either of the two expressions.

x-Q. 75. And on May 5, you swore to your translation of these sentences as amended and improved by Mr. Rice, did you?

A. The amendment and improvement were not suggested by Mr. Rice. There is, as a matter of fact, only one amendment, namely, the one mentioned above, and that was made, *viva voce* by myself.

x-Q. 76. Did you know that Mr. Rice had made the same amendment and improvement in the translation of another translator who has testified in this case? I show you Plaintiff's Exhibit 45.

A. I object to counsel's trying to make it appear, in the face of my definite assertion, that Mr. Rice made any amendment and improvement in my translation. This would be misleading in the record. Furthermore, counsel knows very well that he is giving me an Exhibit 45 which I have never seen before and that consequently I have no means of telling to what extent Mr. Rice did or did not participate, if at all, in the work of other translators.

x-Q. 77. Please answer x-Q. 76, yes or no?

A. Is one allowed to appeal to one's counsel in this hearing?

By Mr. Massie: You will have to answer that question.

A. I naturally did not know, nor did I have any means of knowing.

x-Q. 78. Then, in writing in the word "best" in line 2 of Plaintiff's Exhibit 46, Mr. Rice simply acted as your amenuensis, and wrote at your dictation. Is that what you want to be understood as saying?

A. Yes. In making the translation, I naturally came back on the same ground again in order to check up my translation and noticed that the expression "am besten" could also be

translated by making use of the etymological cognate in English of the German word, and so expressed myself.

It is upon this control of my translation, after it had been made, that the word was inserted by Mr. Rice, who, therefore, can be considered as an amanuensis only from this standpoint and not at all as one who in any way assisted me in the making of my orginal translation.

The original translation "Plaintiff's Exhibit 46" was made in the office of Mr. Rice. There was present, besides Mr. Rice, Mr. Massie, who, however, took no part in the discussion. Mr. Massie simply looked in and most likely wanted to make my personal acquaintance. As I stated in one of my former answers, I was sent down to Mr. Rice upon my own request by Mr. W. E. Pulsifer, president of D. C. Heath & Co. Upon entering the room of Mr. Rice, I made myself known to this gentleman and stated the cause of my errand, asking him if he would not be disposed to show me this German text about which the President of my Company had spoken to me. I was then given a copy of what I have since learned to be Exhibit No. 38 and the two central paragraphs were pointed out to me by Mr. Rice. I believe that it was at this moment that Mr. Massie entered the room and I was introduced to him. Unless I am mistaken, Mr. Massie having been apprised of the reason for my presence in the office, suggested that if need be I should be furnished with a dictionary. This I declined and made the translation as shown in Exhibit No. 46. Thereupon, further social chat ensued between myself and Mr. Rice during which I made the suggestion that the word "best" could also be used. As far as I recollect, Mr. Rice asked me if I would be willing to make an affidavit embodying my translation and the explanation of the differences which I found between my translation and the translation of Dr. Mason which was shown to me in the course of the conversation I am referring to. I expressed my willingness to Mr. Rice and we parted with expressions of mutual esteem. That is all I can say.

x-Q. 83. Are you in the habit of soliciting employment as an expert in this manner. I refer you to the first part of your last answer.

A. I am not in the habit of soliciting employment as an expert translator. I am a man primarily trained in scholarly research and, if counsel will permit me to say so, my curiosity was aroused by the conversation which I had with Mr. Pulsifer. If by employment is meant the rendering of service for a sum stipulated, I may say that I do not know if I am to be paid for the taking up of my time here.

NEW YORK, Friday, July 21, 1922.

CROSS EXAMINATION OF DR. GREEN CONTINUED:

x-Q. 84. In your affidavit, Plaintiff's Exhibit 47, you state that it has been your purpose in making the translation of the two paragraphs from Plaintiff's Exhibit 38 to bring out the intent of the author. Why in this translation which appears in your answer to Q. 5 did you translate "Die Permutit schicht lagert auf feinem * Sande" as "The layer of permutit rests *upon* fine sand?"

A. I respectfully remind counsel that he has misread the affidavit. The affidavit states the word "intendment" and not "intent", and there is, I believe, a legal distinction between these two words. Replying to the second part of the question, I use the word "upon" because that is the correct linguistic translation of the word "auf" in the sentence, as combined with the verb "lagert."

x-Q. 85. In the next sentence of the German text you say in substance that the sand filter is *on* the upper surface of the permutit, do you not? I refer you to your answer to Q. 5. Please answer yes or no, and qualify in any way you see fit thereafter.

A. No. I speak of the sand filter being placed *over* the surface of the permutit.

x-Q. 86. How far over?

A. In a lateral direction all over the surface, as the affidavit states in substance. The author Gans states that the sand filter is placed over the surface of the layer of permutit and, as I said above, this relation is one of simultaneous lateral direction and cannot but imply contact.

I understand Gans to mean in this article that the sand filter rests upon the bed of permutit and that there is no space between.

Referring to my understanding of this second sentence that the sand filter rests directly upon the permutit bed, and asked if this idea would not have been expressed very accurately by the words "lagert auf", I reply I am not a technical expert in the art of filters or softeners, hence cannot deal with probabilities. The author Gans does not in these two sentences express the idea of "resting upon"; he manifestly defines the lower and upper *boundaries* of the layer of permutit, hence he says in the first sentence that said layer *rests upon* fine sand, while on its upper surface it is *bounded by* a sand filter.

The words in this German text which I translate as

"bounded by", mentioning the words in the order of the German sentences, are "von" and "abgeschlossen."

Asked whether there is any difference in my mind, so far as conveying the same idea is concerned, between saying "I stand upon the carpet" and saying "While standing the bottom of my foot is bounded by the carpet", I reply, yes. In the first sentence the act of standing is brought out; in the second, this standing is a subsidiary idea to express the time when the foot is bounded by the carpet. The practical difference, so far as the pressure of my foot upon the carpet is concerned, would depend upon the pressure exerted. There is no difference in "pressure exerted" conveyed to my mind by these two sentences. Asked whether it is my idea that no pressure is implied in the first sentence by the words "I stand upon" and in the second sentence by the words "While standing", I reply, I would rather use the word "weight" in this connection as the word "pressure" to my mind conveys rather the purposeful application of weight or force. Counsel is right in implying that there is "weight" upon the carpet when one stands upon the carpet.

I am of the opinion that Gans meant to say in this article that the "weight" of the sand filter was on the permutit bed. This is clearly implied in Gan's statement to the effect that the sand filter is placed over the upper surface of the layer of permutit.

BERNARD R. REGEN, a witness for plaintiff, testifies:

My name is Bernard Richard Regen; age 36; residence, 284 St. Paul's Avenue, Tompkinsville, Staten Island; am a technical translator.

I got my education in Berlin and have for the last ten years been a technical and scientific translator of both the above named art and also of electro-technics, working since 1912 in a special department of both the General Electric and Westinghouse companies, and outside of that for a number of the most important patent attorneys of New York City and out of town. For instance, Pennie, Davie, Marvin & Edmonds, Fish, Richardson & Neave; Kenyon & Kenyon; Stockbridge & Borst; Sheffield & Betts, and others. I have with me a record of my translation work covering the period since 1912 and showing that the average volume of work per annum amounted to about 700,000 words. I also submit a random list of samples of subjects of translation work, all of which exclusively of a technical, scientific and patent nature. I have, I believe, an innate talent

for doing translating work ever since I went to school. In fact, in doing translating work from German into Latin, for instance, my teacher always doubted that I was doing the work myself unaided. I can give besides personal names of individuals I have been working for and who will give testimony as to the quality of my knowledge and work. I went to school until the age of 18. My parents found it impossible to let me complete my studies for financial reasons, and so I had to fall back upon the auto-didactic method, that is, self-teaching, and the visiting of evening school of the municipality of Berlin. I had been reading engineering literature on a large scale and by the time I took up my work with the General Electric and Westinghouse companies I was, in spite of six weeks examining, found fully qualified for doing translation work of the character involved. That was in 1912. In the meantime, that is, the last ten years, I have had such a great chance of improving my knowledge and qualifications that I dare say I can consider myself a good translator.

I identify three sheets of typewritten manuscript, purporting to be an affidavit, as one I signed on May 5, 1922.

Copy of affidavit offered in evidence and marked "Plaintiff's Exhibit 48 Copy of Regen Affidavit."

The translation prepared by me of the two middle paragraphs of Plaintiff's Exhibit 38, Gans Article, page 199, as set forth in my affidavit is as follows:

"The apparatus consists of an iron or wooden filter. The depth (Höhe) of the permutit layer is governed by the hardness of the water to be treated and the rate of filtration, the useful effect being so much higher the slower the rate at which the water flows through the permutit filter and the finer the grain of the permutit.

The permutit layer is rested upon fine sand becoming coarser downwardly. On top it is most conveniently closed by a sand filter having a depth (Höhe) of about ⅓ to ½ m above the surface of the permutit layer. The sand filter may under certain circumstances be replaced by a lime-stone filter, for instance, when waters containing iron and acids are dealt with. This arrangement of the top sand filter or lime-stone filter is further intended to prevent the specifically lighter permutit particles from being flushed away mechanically by back-washing."

I consider the translation which I have just dictated into the record a full, fair and correct translation of the full para-

graphs on page 199, right-hand column, commencing "Die Apparatur" and terminating with the words "abgeschlämmt werden" in Complainant's Exhibit 38.

I do consider it a correct translation, possibly, with the exception of my rendition of the word "abgeschlämmt" which I interpreted at that time as meaning in the original German text flushed or washed off or away. After giving this particular word a little more thought in the last few days I discovered that in one of the standard technical dictionaries I find as the equivalents for "abschlämmen" the English terms "elutriation, levigation", the dictionary in question being "Technologisches Worterbuch" by Egbert v. Hoyer and Franz Kreuter, published in Wiesbaden in 1902. I would now preferably render the ultimate sentence of the second paragraph cited as follows:

> "This arrangement of the top sand filter or limestone filter is further intended to prevent the specifically light permutit particles from being mechanically elutriated or levigated by backwashing."

One or two days previous to the signing of the affidavit I was requested from the office of the firm of Philipp, Sawyer, Rice & Kennedy, No. 220 Broadway, to render a translation to the best of my ability of the two paragraphs of the original German text under dispute. I met when calling at the office Mr. Rice and Mr. Massie. Mr. Rice showed me a photo printed copy of the original German article, asking me to translate the same and pointed out to me the gist of the matter in the words "is there contact or is there not." I refused to consider the opinion previously given by another man, I took the photostated copy to my office and prepared the same afternoon a translation of the two pertinent paragraphs and I believe the following day I took the translation back to the above named office, the affidavit being signed as stated on May 5, and I declare that the text appearing in said affidavit upon my perusal proved to be the same as my original save for two typographical errors.

I cannot produce the original draft as I make it a business principle followed for the sake of preserving secrecy of all work done for my clients to throw away all data and information used in connection with work done by me for clients. Of all the work done by me during the last ten years there is not one scrap left.

Apart from my personal experience—in rendering "Höhe" into English as "thickness" or "depth" I can cite offhand "Illustrated Technical Dictionary in Six Languages", Vol. III, by Wilhelm Wagner, of the Deinhardt and Schlomann series, in

which on page 23, there appear as an equivalent for the German terms "Schichthöhe" "Schütthöhe" "Höhe der Schuttung" the English terms "thickness of fire, depth of fuel layer"; the definitions being accompanied by a sketch showing a grating with a layer of fuel arranged over the surface of said grating, and the "Höhe der Schüttung", that is, the thickness or depth of the fuel layer being referred to by a letter *a*. I further refer to *a* or the "Technologisches Wörterbuch" by Tolhausen, Ph. D., in which on page 426, under the general heading of "Höhe" there is more particularly given as an English equivalent for "Höhe der Offnung" (steam engineering) the English term "depth of the port." And ten lines further above, as an English equivalent for the German term "Höhe der Deckfläche" (steam engineering), "depth of the valve." As to the meaning of the word "Höhe" as used by the author Gans, this can be proven by grammatical mathematics, so to speak. Gans uses (may I refer to the original) the words "Die Höhe der Permutitschicht richtet sich", etc. And about 20 lines further below he uses the word "Jedes Filter enthält * * * Permutite in ca. 70 cm hoher Schicht." Hence, Höhe hohe Schicht. Now, substituting hohe Schicht for Höhe which Gans used in the paragraph on page 199, right column, beginning with the words "nach oben hin" and ending "angebracht ist" we get a sentence reading as follows: "Nach oben hin wird sie am besten von einem Sandfilter abgeschlossen, das in zirka ⅓ bis ½ m *hoher Schicht* über der Oberfläche der Permutitschicht angebracht ist." If the author had had the intention of conveying the idea of fact that there is an intervening space between the surface of the permutit layer and the top sand filter, in other words, that there is no physical contact between said permutit layer and the top sand filter he would either have used a word like "Abstand", "Entfernung", or "Zwischenraum", or more simply he would simply have said * * * das zirka ⅓ to ½ m über der Oberfläche der Permutitschicht angebracht ist."

This meaning is, so far as my recollection goes, what Dr. Mason introduced into his translation by skipping the word "Höhe." As far as my experience as a translator of technical matter is concerned, it is hard to say, generally speaking, as to when "Höhe should be translated as depth or thickness. However, it would seem to me that whenever Höhe is used in German and when it refers to bodies that have small measurements in the vertical sense as compared with their measurements in horizontal sense the word "thickness" or "depth" according to my feeling should preferably be used.

When calling at the office of Philipp, Sawyer, Rice & Kennedy, and meeting Mr. Rice and Mr. Massie, I also saw Miss White at her desk and a gentleman whose name so far as I remember was something like Kriegsheim or Kriegsberg, who dropped in while I was in the office.

CROSS EXAMINATION:

I keep a record of service I render to clients in the shape of the bills I submit to them. This does not show the dates on which the service is performed. I have no memorandum of such service showing the dates when performed. The only way in which I am able to fix the dates when I did any work on this translation is from memory. In fixing the date of course I can, apart from the bill I rendered which possibly was rendered a week after rendering of services therein charged for, be guided only by the date of the affidavit. I have no further basis or data for fixing dates. My testimony concerning the service connected with this translation and the making of the affidavit are purely matters of memory, excepting the date May 5 on the copy of Affidavit Plaintiff's Exhibit 48. The time elapsed between the hour where the photostatic copy was handed over to me and the time of signing the affidavit was one and one-half to two days, representing about four hours of service. I received the translation of an afternoon around three or four o'clock and they were returned on the day following the next; that is, for instance, if it was on Wednerday I returned it on Friday. I do not recollect what day of the week it was when I made the affidavit Plaintiff's Exhibit 48. According to a calendar shown me, it was Friday, May 5, 1922. I first had knowledge of this article on Wednesday, between three and four o'clock. After receipt of the photostat text to be translated I may have shown it to Mr. C. V. Bertsche, although we had not had any discussion about it, because even if I had intended to talk about the matter Mr. Bertsche is usually so busy that he cannot be disturbed in his work. I did talk cursorily with him about the translation. If you mean by conversation the question put by Mr. Rice to me as to whether there was contact or not, that was the full conversation I had prior to that time, for at the finish of his question the photostatic copy was submitted to me or simultaneously therewith. I received the "photostatic text" referred to in Mr. Rice's office in the adjoining room. In the forenoon of Wednesday, the 3rd day of May, 1922, or thereabout, as far as my recollection goes, I called at the office of a client of mine, Mr. Frank Waterman, who told me that he

had heard about some work having to be done at the officers of the firm of Philipp, Sawyer, Rice & Kennedy. I thereupon called at these offices and events took place as described.

I found Mr. Waterman in conference with two gentlemen unknown to me. Mr. Waterman discontinued his conversation with them for a minute; went to the telephone, called up the offices of Philipp, Sawyer, Rice & Kennedy, and asked whether this work was still to be done. While he was waiting on the receiver to get the proper party on the wire, he roughly repeated that the text to be translated centered around the question whether there was contact between two layers in a filtering apparatus. That was the full conversation I had with him. That was while he was hanging on the receiver and did not know whether the work was or had actually to be done. After I learned through Mr. Waterman that my services were still required, I went over to 220 Broadway to get in touch with the firm.

I just happened to drop in to Mr. Waterman's office to pay him a visit. I hadn't seen Mr. Waterman for five years I believe, the last time in connection with a Marconi litigation. Mr. Waterman did not tell me that he was an expert witness in this case. I had the impression that it was just chance information that he knew about these services to be rendered, and I did not know thoroughly up to this minute that Mr. Waterman was in any way connected with it if at all.

Asked whether Mr. Waterman said that the apparatus was a filter or a water softener, I am pretty sure that he did not mention the word "softener." I would not even say that he used the word "filter", although I am inclined to believe that he did.

Referring to my statement that the thing the translation concerned was whether there was contact between two layers in a filtering apparatus and asked what Mr. Waterman said about these layers, he said that I should go over and read the original German text and see how I would translate it. He said if the work was still to be done that I would probably be requested to make my translation into English of the original German text and that the case was very interesting in view of the fact that there seemed to be doubts about the question whether there was physical contact between layers.

x-Q. 45. Twice you have not answered questions I asked you, and volunteered some inappropriate statement; do you do this to gain time to think

A. Not at all; and if any particular points should have been left unanswered I wish they would be pointed out to me. You

ask me "What did he say about these layers" and I answered that there were doubts about the question whether there was physical contact between these layers.

x-Q. 46. Did he say that the layers were of the same kind of material or of different material?

A. No; he mentioned the materials that were involved.

x-Q. 47. Well; just what did he say about the nature of the material of which those layers were composed?

A. He said that they were layers of permutit, a material wholly unknown at that time to me, and sand.

x-Q. 48. You knew of the Permutit Co. from your reading of technical literature, did you not?

A. Yes; I may have come across their name, but their products were unknown to me.

x-Q. 49. Did he say which of these layers was at the top and which at the bottom?

A. No; I don't think he did give me those details.

x-Q. 50. Did he say that one translator said that the article read so as to make a space between the permutit layer and the sand layer?

A. No. What he did say was that it was a question of whether there was contact between layers which inferentially means that if there was not, there must necessarily have been a distance or separation.

x-Q. 51. Then all you gathered from what Mr. Waterman told you was that there was a question as to whether one of these filter layers lay upon the other like two pancakes, or whether the upper layer was held above the other in some way, leaving a space between them; is that correct, or if incorrect add the rest.

A. Mr. Waterman did not go into any such details; he simply said that it was a question of whether there was contact or not. He did not mention anything about one of the layers being held away from the other by any means whatever.

x-Q. 52. Then from what he told you you had no picture in your mind of the two possible constructions; is that what you want to say?

A. Yes; no preconceived idea.

x-Q. 53. Then what he said didn't mean anything to you as to the question involved in the coming translation; is that so?

A. Naturally when he imparted the above information to me I must have had some idea in my mind even very vague or cloudy in shape or form as to what was involved. Otherwise, of course, as I have said, my mind was entirely open.

x-Q. 54. I didn't ask you anything about what must have been in your mind. I asked you what was in your mind. Please don't evade. Look at x-Q. 53 on the record and answer the question.

A. What was in my mind between the time when I saw Mr. Waterman and Mr. Rice I am unable to tell now in detail, because on any given day I have at least six or seven different translations in work, translations that especially previous to the starting of the work leave no—and cannot leave any lasting impression.

x-Q. 55. After leaving Mr. Waterman's office with no distinct idea in your mind of what the matter involved was, what did you do to clear it up, and who cleared it up for you?

A. Do you mean between the time of seeing Mr. Waterman and Mr. Rice?

x-Q. 56. x-Q. 55 is plain enough even for an expert. Please answer it.

A. After I had seen Mr. Rice and received the photostatic print from him I had no one, and I make it a point in all work that I do not to consult anybody as to what anything in the line of translation work may mean, so I was thrown back entirely on my own intellectual and mental resources.

There was no substantial conversation as to the merits of the disputed meaning on either side. Mr. Rice had on his desk a yellow sheet, if I remember it, on which some one's previous translation had been put down. He held it in his hand and said would this be your idea. I did not take the sheet because I felt I did not want to be influenced in any way whatever no matter by whom arguments may be brought upon me.

x-Q. 58. Was this yellow sheet signed with any name?

A. I can't tell you because I was in my position just opposite Mr. Rice.

x-Q. 59. Was the writing in pen and ink or in pencil?

A. I think the writing was in pencil.

x-Q. 60. Did it show evidence of changes and interlineations? Or was it a perfectly uniform writing?

A. It was as I have said a yellow sheet and I did not observe any corrections on it or interlineations. It seemed as though the thing had been written down without a moment's hesitation or hitch.

x-Q. 61. Did Mr. Rice say whose translation it was?

A. No.

x-Q. 61. Who else was in the office while you and Mr. Rice were having this conversation?

A. There were furthermore Miss White and a gentleman by the name of "Kriegsberg" or "Kriegsheim."

x-Q. 62. Any others?

A. No; excuse me, Mr. Massie was there too.

x-Q. 63. Did Mr. Rice know in advance that you were going to call upon him May 3rd.

A. I don't recollect whether Mr. Waterman told him that I would come over the same day, although I believe Mr. Waterman advised Mr. Rice that I would call at his office. Mr. Rice up to that time was unknown to me. I must confess that I did not even know the name of the firm. I had never heard of Philipp, Sawyer, Rice & Kennedy.

Asked how many times I have appeared as a patent expert in the last ten years, just on one or two occasions at Sheffield & Betts's office; but I have been called upon unofficially to decide problems of a similar nature by patent attorneys, the engineers of the General Electric and Westinghouse companies on frequent occasions. It may only be once in five hundred translations which I can prove I have made there was a necessity for calling me as a witness. As to the quality of my work, I do not think that there can be any question in view of the fact that I have had these firms and still have these firms as clients.

Asked to cover up my papers and then translate into German the following:

"The height of the permutit layer depends upon the degree of hardness of the respective waters and of the filtration speed. The useful effect is so much greater the slower the water passes through the permutit filter and the finer the grain of the permutit is.

The permutit layer lies upon fine sand which is getting coarser towards the bottom. Above it is best closed by a sand filter which is placed at a height of about from ⅓ to ½ meters above the surface of the permutit layer."

I translate:

"Die Höhe der Permutitschicht hangt von dem Haertegred der ontsprechenden Waesser und der Filtrationsgeschwindigkeit ab. Der Nutzeffekt ist um so groesser, je langsammer der Wasser durch der Permutitfilter fliesst und je feiner die Koernung des Permutits ist.

Die Permutitschicht ruht auf feinen Sande, der nach unten groeber wird. Oben ist sie abgeschlossen von einem Sandfilter, das ⅓-½ m ueber der Oberflaeche der Permutitschicht angebracht ist".

I haven't had any conversation, direct conversation, with Mr. Kriegsheim. So far as my recollection goes Mr. Kriegsheim made a chance remark about the way the passage in question may be interpreted. He said, as everybody knows, that abgeschlossen means shut off and closed, I think was the way he defined the meaning of the original German word. There was no additional discussion nor further remark about the point. I don't remember what led up to the discussion of the word, probably because it was the first word that struck him in the paragraph in question. Mr. Kriegsheim positively did not make any remarks on this point in my presence, so I am entirely ignorant as to whether he saw the document for the first time or not. I had no previous discussion with Mr. Rice or Mr. Massie or Mr. Kriegsheim respecting this Gans article. Simply the question arose and I believe Mr. Kriegsheim asked me how I would translate the word abgeschlossen. I simply concurred and this represented my offhand judgment at that time without my having had any chance of reading the context, stating that "shut off" and "closed" appeared to me good words to use.

x-Q. 79. And are you willing to say now, under oath, that you discussed the word "abschlossen" without discussing the word "Hoehe" in the same sentence?

A. It may be that we also discussed Hoehe, although I would not take it on my oath that we actually did discuss it. I won't say on oath that I didn't discuss Höhe.

I would not take an oath that I didn't discuss Höhe. There were present upon my entrance Miss White, Mr. Rice, Mr. Massie and Kriegsheim.

x-Q. 83. Then, why did you say in your answer to Q. 16 that Mr. Kriegsheim "dropped in while I was in the office?"

A. Because when I made that answer that he was either coming in or standing at the door. Mr. Massie was seated on the sofa and I believe Mr. Kriegsheim about the time I entered came from an adjoining room. He evidently had been in the office prior to my arrival, because I do not think he had his hat.

I translate into German "The blanket is five centimeters thick" as "Das Bettuch ist 5 cm. dick."

I made my first oral or written translation of the portions of the Gans article referred to the same afternoon in my office. I left it on my desk, or in my desk, until the time when I had agreed I would take it over to sign the corresponding affidavit. This first translation was used in making up my affidavit, Plaintiff's Exhibit 48. My translation was bodily incorporated in the said affidavit which was drawn in Mr. Rice's office. I have

not seen my original translation since then. After the text was copied into the affidavit I took my original along to my office and destroyed it, as I usually do with all rough drafts of my work.

x-Q. 89. Is this another case of "spurlos versenkt"?

A. Yes, it is. If you want to classify it under this heading you are welcome to it.

x-Q. 90. What is the most common, ordinary translation of the German work "Höhe" when it is used not as a compound but standing alone?

A. I have no statistical data in which to use in answering this question, although I am inclined to believe that popularly it stands for height.

Noting that I now prefer to translate the word "abgeschlämmt" as "elutriation" or "levigation", instead of "washed off", "washed away", "flushed off", or "flushed away", and asked to give English definitions of these two words I now prefer, and point out the difference in meaning between the words "elutriation" and "levigation" and the words, "washed away", I would say that the English definitions for these two words, so far as I know them, are that "elutriation" stands for the same thing as "washed off", whereas "levigation", as far as my knowledge goes, and as far as I can judge from the derivation of the word from Latin, stands for "grinding," "rubbing", in the presence of a liquid, by physical or mechanical means. Therefore, while in my conception there may be no difference between "elutriation" and "washing away", there may be a difference between "levigation" and "washing off".

At the time when I made my translation of the word, that is at the office, I did not consult a dictionary but merely followed the best of my knowledge in the rendition thereof into English. About five days ago, however, I had a talk with a translator known to me who, while there was no doubt in his mind about the rest of the paragraphs in question, called my attention to my interpretation of the word "abgeschlämmt". On coming home from the office that night, I consulted a dictionary which I permanently keep at home, and fonnd therein the two definitions above referred to, that is, "elutriation" and "levigation". The name of the translator I was lucky enough to meet that afternoon to give the very desirable enlightenment is Mr. Buck. I do not have his address as the man is only known to me from meetings we have had in the technical libraries of New York. His address, however, can be ascertained by me.

x-Q. 93. Name all the persons in addition to Mr. Rice, Mr.

Massie, Mr. Kriegsheim, Miss White, Mr. Buck and Mr. Bertsche, with whom you have talked about this Gans Article, Plaintiff's Exhibit 38.

A. Subsequent to the time of signing the affidavit I have had a cursory talk outside of the conversation with Mr. Buck only with Mr. Herman Kusterer whom I happened to meet at the Engineering Library at 39th St. about ten days ago. His address is 182 Madison Ave., New York City.

Asked what idea is conveyed to my mind by the word "levigation" involving grinding action, as I have testified is my preferred translation of abgeschlämmt, in connection with the sentence in which it is found of the Gans article, I would say that on studying the two paragraphs it became clear to me (may I refer to the original) that the first half of the second paragraph in the middle of column 109 must have some connection with the last sentence of said second paragraph, because the author says that for reasons of this upper sand or limestone filter being arranged certain ends are aimed at. And it seems to me that by virtue of the pressure of such top sand layer the permutit layer is so to speak immobilized.

The author says that he places the top sand layer over the permutit in order that as I understand it levigation of the specifically light permutit for mechanical reasons may be prevented on back wash, that is, when water is forced through the apparatus it stands to reason that it will bring the small particles to rub against each other when they are free to do so, that is to say, when there is no load pressing upon them and holding them firmly in place, that is the idea that I infer from the original German text.

x-Q. 99. Then, you understand Gans to mean that if this permutit bed lay loose without anything to hold it down in place then the particles of permutit would rub against each other and destroy themselves, or wear each other out, in the back washing process. Have I caught your idea correctly?

A. In selecting the two substitute words to take the place of the term originally used, I was wholly and exclusively guided by the definitions I found in the technological dictionary subsequently to my originaly translation discovered, and, in conformity therewith I had of necessity, as a conscientious translator, and also for further use, to adapt my conception to what the author and his language might have meant, and what I have answered in the answer to Q. 98 is what I believe Gans meant to convey at the time when he wrote this article.

I cannot say, putting it in a nutshell, that my judgment of the meaning of the pertinent sentence is that by virtue of the

fact that the top sand layer was resting on the permutit attrition of fine permutit particles was prevented.

x-Q. 101. I don't want to know what you can't say. I want to know what you can say as an expert translator of this Gans German text, and I ask you to again look at x-Q. 99 and try to give us a simple, intelligible answer.

A. All I can say in addition to the quite lengthy explanation given in the answer to Q. 99 is that the arrangement of the top sand layer is resorted to as otherwise the fine specific light permutit particles would be subject to attrition on back washing.

x-Q. 102. Please answer x-Q. 99?

A. And that is the full conception that I have of the pertinent paragraph. I am unable to make any additions to what I have said on this point in the last three questions as much as I like to.

x-Q. 103. Please answer x-Q. 99 which is a simple question capable of a direct answer?

A. The answer to x-Q. 99, if I might dare to interpret what Gans says and to read his mind is that if this permutit bed lay loose without anything to hold it down in place then the particles of permutit would rub against each other and destroy themselves. This is what I believe he tried to convey and what I think I substantially said in answering x-Q. 98.

ANN ARBOR, Michigan, Aug. 17, 1922.

JOHN W. SCHOLL, a witness for Plaintiffs, testifies:

My name is John W. Scholl, aged 53, my residence is 917 Forest Avenue, Ann Arbor, Michigan. My occupation is Professor of German in the University of Michigan.

After the usual High School education, I studied at Valparaiso College, Indiana, from 1893 to 1896 inclusive. Then I served as Professor of modern languages in Chattanooga Normal University from 1896 to 1900. Then entered the University of Michigan, making special study of German and French and graduated A. B. in 1901. I was immediately appointed instructor in German at the University of Michigan, and continued graduate study, taking the degree of A. M. in 1902, and the degree of Ph.D. in 1905. I have served as Instructor and Professor in the University of Michigan continuously to the present. My work has been teaching German, with the exception of a period of four years during and after the late war, during which period I was detailed to teach French.

Throughout my period of German teaching it has been a regular part of my duty to conduct the class in Scientific German required of students intending to enter the Medical School, or to continue special studies in Chemistry.

I present a translation of a part of the German text in the right hand column of page 199 of Plaintiff's Exhibit 38, Gans Article of Apr. 15, 1909, together with a complete parsing of all the words contained in the specified text. This includes the translation of every word and at the end a translation of the whole paragraph into English. It refers to a paragraph in second column, page 199, beginning "Die Permutitschicht" and ending, "Mechanisch Abgeschlaemmt Werden". The translation reads as follows:

> "The permutit layer rests on fine sand that becomes coarser toward the bottom. At the top it is best finished off (or closed off) by a sand filter, which with a thickness of about one-third to one-half meter, is arranged over the surface of the permutit layer. Under many circumstances, the sand filter is better replaced by a limestone filter, for example, in the case of iron-containing and acid waters. This arrangement of the upper sand or limestone filter is intended further to hinder the specifically light permutits from becoming mechanically washed away in case of backwashings."

The "complete parsing" is offered in evidence as "Complainant's Exhibit 50."

From my experience in the translation of German, it is my opinion the translation and parsing in Complainant's Exhibit 50 is a full fair and correct translation and parsing of the respective words in the said full fifth paragraph, second column, page 199 of Complainant's Exhibit 38, Gans Article of April 15, 1909.

I have made a complete translation of the article in question, and herewith present it.

> The typewritten translation produced by the witness and comprising five pages, is offered in evidence and marked "Plaintiff's Exhibit 51."

Referring to a comparative arrangement of the German text and the corresponding English words prepared by Dr. Francis P. Mason, one of the witnesses for Defendant, I have prepared a similar arrangement of the German and its translation into English and, according to my views, herewith present it.

This comparative arrangement is offered in evidence as Complainant's Exhibit 52.

The circumstances under which my attention was first called to this German text corresponding to Complainant's Exhibit 38, are as follows: By telephone, a meeting was arranged for Mr. M. C. Massie at my house one evening earlier in the summer at which he presented to me the paragraph in question in the Article by Dr. Gans, and asked me to look it through and translate it. I did so, and proceeded to make the translation orally. At one point I found a passage whose meaning depended upon the context. I asked to have opportunity to learn the context. I then looked back and forward to preceding and following portions of the article, and also asked whether anything could be told me about the process involved. I then finished the translation as requested.

Auf is a preposition which indicates either rest upon, or motion upon a place. A very small amount of dust heaped up at one spot of a table would be "auf dem Tisch". If it were intended to express the fact that dust lay over the whole table, auf would not express that fact, but we use ueber to express it as "ueber dem Tisch". The translation of the entire article was carefully made and compared twice with the original and is offered as a full, fair and complete translation of it.

CROSS EXAMINATION BY MR. KNIGHT:

The comparative arrangement sheet prepared by Dr. F. E. Mason is offered in evidence as Complainant's Exhibit 53. No portion of my education was received in Germany and I have never been in Germany. The college of the University of Michigan with which I am connected is the College of Literature, Science and the Arts. In its organization of officers and management, it is entirely separate from the Engineering College, but many classes are taken in common by students in both colleges.

In Valparaiso College I took the so-called Scientific course, there being no Engineering College in connection at that time. There was no Engineering course in the Chattanooga Normal University where I spent four years. I am not the head of my department in the University of Michigan. Professor Max Winkler is the head.

The works of Schiller, Goethe, and other German literary masters do not constitute the bulk of the German with which I have to deal in my teaching. We use the literature of the writers of the present date, and in my course in Scientific Ger-

man we read the very latest and most authoritative writers of books and journal articles in the field of science, always including generous amounts of chemical, physical and other scientific subjects. I had not come in contact with any treatises or articles by Dr. Robert Gans prior to the submission of this one, Plaintiff's Exhibit 38, to me for translation. I had never heard of him. I knew nothing about the softening of water by means of permutit prior to the reading of this article.

The passage I found whose meaning depended upon the context was the phrase, "In zirka ⅓ bis ½ m. Hoehe." You are correct in stating that after finding that I needed some information outside of the paragraph on this passage which you have just pointed out, that I looked at other parts of the article, both before the passage and after it, and still being in need of outside information, asked Mr. Massie whether anything could be told me about the process involved.

Mr. Massie, when I asked him whether anything could be told me about the process involved, gave me a brief statement of what was involved in softening of water, and the necessity of the water passing through the permutit filter. I do not recall that he gave any other technical information.

x-Q. 29. Repeat as nearly as you are able in Mr. Massie's words all that he said to you in response to your request for information about the process involved.

A. Such an answer is practically impossible.

x-Q. 30. Please do the best you can.

A. I have stated the substance of the information.

x-Q. 31. The idea of a witness as to what constitutes the substance of what some one else said is not proper evidence. It is the duty of a witness to repeat so nearly as he is able, the thing said by the other person. In this statement of the law of evidence, I believe Mr. Massie will bear me out, and I therefore ask you to answer x-Q. 29 as explained in x-Q. 30.

A. I can not upon my oath repeat the identical words of Mr. Massie's statement, because I do not recall them, and I have since received knowledge of the process involved to such an extent, and in such form, that I can no longer distinguish the exact amount I then received, but to the best of my memory, I merely learned, that water had to pass through the permutit filter which was of such a nature as to remove chemically the hardness of the water.

Mr. Massie did not explain to me what permutit was.

He pronounced the word permutit in connection with the paragraph in question, but did not explain what it was chemically, nor how it behaved chemically, except that it removed

the harness from the water. I did not know anything of its constitution, but understood it to be a mineral because it was referred to as granular. Asked whether I knew at that time that this granular permutit when used for softening the water was placed in some sort of a container through which water was passed during the softening operation, I reply that I saw by the paragraph preceding and the paragraph following that it was placed in a container. I knew nothing more than what is contained in the preceding and the following paragraphs.

After Mr. Massie had explained to me "about the process involved", and after I had read through the preceding and the following paragraphs in which the words "Hoehe" and Hoch are used in the sense of depth or thickness, my decision as to the interpretation was made.

x-Q. 38. What was it that Mr. Massie told you about the process that helped you in arriving at your decision?

A. It helped in the interpretation of the preceding paragraph in which the passage occurs "Die Hoehe der Permutitschicht richted sich nach dem Haertegrade des betreffenden Wassers und der Filtrationsgeschwindigkeit."

x-Q. 39. Now please answer x-Q. 38.

A. The fact that the layer of permutit was arranged in accordance with the degrees of hardness of the water indicated that the word "Hoehe" was being used by this writer in its sense of thickness or depth, and not possibly in the sense of altitude.

x-Q. 40. Now please answer x-Q. 38, which has not been answered in the slightest degree by either of your foregoing volunteered statements. The typist is asked to read you x-Q. 38, or you are invited to look upon the record before you, and both.

A. Your question asked about the picture in one's mind. The picture expressed by "Hoehe" in that sense is simply a conception of a layer in a container, the layer having the thickness stated.

x-Q. 41. I asked you nothing whatever about a picture in x-Q. 38. I asked you what it was Mr. Massie told you about the process that helped you in arriving at your decision. I have a right to answer to the question, and I insist upon its being answered.

A. I have already answered explicitly that point.

x-Q. 42. In your statement following x-Q. 38 you apparently told in what way whatever Mr. Massie told you helped you. *That I did not ask.* I asked you what it was that he told you which helped you, and that's what I again ask.

A. The fact that water had to pass through the filter to

have its hardness removed was a deciding factor in determining the meaning of "Hoehe."

"Hoehe" designates always the vertical distance between two points, and its translation by height, depth, and thickness are all good and in excellent use, and it would be difficult to state which is the more common. The selection of the English word is determined usually by the direction of measurement, whether upward or downward, and also by the general dimensions of the thing to which the adjective is applied, or for which the abstract noun is used. My selection of the particular English word which best translates the German word "Hoehe" was determined by my understanding of the context.

Plaintiff's Exhibit 50, Complete Parsing by Dr. Scholl.

(Stipulated from Permutit v. Wadham)

COMPLETE PARSING BY DR. SCHOLL

Complete Parsing of a Paragraph in Article by Dr. Gans.

* * * * * *

'Die—Def. Art. fem. sing. nominative case, modifies 'Permutitschicht'; means 'the'.

'Permutitschicht'—noun fem. sing. nominative case, subject of the following verb 'lagert'; means 'permutit layer'.

'lagert'—verb, intrans. indicative mode, pres. tense, sing. third person of 'lagern', to agree with its subject 'Die Permutiteschicht': means 'lies upon' or 'rests in a layer upon'.

'auf'—preposition governing dative case when location is expressed, and accusative case when limit of motion to or upon an object is expressed; here governs its object 'Sande' in dative case, and means simply 'on'.

'feinem'—descriptive adjective, dative, sing. masc., to agree with 'Sande' which it modifies: means 'fine', *i. e.* fine-grained.

'nach—zu'—a so-called compound preposition, really two prepositions, one placed before and the other after its object, which they govern in the dative case. They together express direction of movement and mean 'toward'.

'der Tiefe'—the def. art. with an abstract noun of quality derived from the adjective 'tief' (= deep); here in the dative case governed by the compound preposition 'nach—zu'; the phrase 'nach der Tiefe zu' means simply 'downwards' or 'towards the bottom'.

'gröber'—descriptive adjective, comp. degree of 'grob' (= coarse); means 'coarser' and modifies as its predicate the following word 'werdendem'.

'werdendem'—pres. active participle of the verb 'werden' (= to become); here used as an adjective in dat. case, sing. masc. to agree with 'Sande' which it modifies; means becoming'.

'Sande'—noun, masc. sing. dat. case, object governed by the preposition 'auf'; means 'sand'.

* * * * * * * * * *

'Nach'—preposition meaning 'toward'; does not govern a noun here, but is combined with the following adverb.

'oben'—which means 'above', and further with

'hin'—a direction particle which indicates motion in a direction away from the point of view of the speaker or away from the point of departure of the movement. The phrase 'nach

oben hin' means 'upwards' or 'towards the top' or simply 'at the top' when motion is not emphasized.

'wird'—pres. indicative, third person sing. of the verb 'werden', to agree with its subject 'sie'; here used as an auxiliary verb with the perfect participle 'abgeschlossen' to form a true passive voice of the verb 'abschlieszen' (= to close off, or finish off); here equal the English auxiliary 'is' in passive voice.

'sie'—personal, pronoun, feminine, singular; its antecedent is the feminine singular noun 'Permutitschicht'; it is in the nominative case, subject to the verb 'wird—abgeschlossen'. It is the Permutite layer which is 'closed off' or 'finished off'.

'am besten'—superlative degree of the adverb 'wohl': modifies 'abgeschlossen'; means 'best'.

'von'—preposition governing dative case. Its object is 'Sandfilter'. This preposition is regularly used with the passive voice of verbs to point out the personal agent or instrument of the action expressed by the verb; here it means 'by'.

'einem'—indef. art. sing. neut. dative case, to agree with 'Sandfilter'; means 'a'.

'Sandfilter'—noun, neut. sing. dative case, object of preposition 'von'.

'abgeschlossen'—perfect participle of the verb 'abschlieszen'. This verb has a variety of shades of meaning, the correct one being always determined by the context. It may mean 'to close off', 'to lock off', 'to shut off', 'to finish off', 'to conclude', 'to complete', and the like. Here it must mean either 'finished off' or 'closed off', inasmuch as the verb 'wird—abgeschlossen' is affirmed of its subject 'Permutitschicht', and not of some open room or container which could be locked or shut.

'das'—relative pronoun, neut. sing. to agree with its antecedent 'Sandfilter'; nominative case, subject of 'angebracht ist'.

'in'—preposition governing dat. case when location is expressed and accusative when limit of motion is expressed. Here governs dative case; its object is 'Höhe'. It has a variety of translations in English owing to the idiomatic character of many of the phrases in which it appears: means 'in', 'at', 'on', often equivalent to the English 'with' in certain idioms: here 'in' or 'with', according to choice of idiom; as, 'in depth' or 'with a thickness'.

'zirka'—the Latin preposition *circa* Germanized; means "approximately'.

'bis'—preposition governing accusative case, used to express range from one point to another: here 'from one third to one half meter'.

'Höhe'—abstract noun from the adjective 'hoch'; here used in dative case, object of the preposition 'in'. This word frequently means simply 'height', but its sense varies with the context, so that it often means 'thickness'. It always signifies the *vertical distance between two points or surfaces*, but in case of objects like courses of brick or stone in buildings, strata of rocks in the earth's crust, layers of any kind resting horizontally one upon another, the word 'Höhe' is equivalent to the English word 'thickness'. The author of the article containing the paragraph in question uses the word 'Höhe' in two other places in the article, where it is impossible for it to mean anything else than 'thickness', namely in the paragraph immediately preceding and in the one immediately following the one in question. In the former he says: 'Die *Höhe* der Permutitschicht richtet sich nach dem Härtegrade des betreffenden Wassers', which means; 'The depth or thickness of the permutite layer is governed by the degree of hardness of the water concerned'. To substitute such a word as 'altitude' here would make nonsense of the passage. In the latter case he says: 'Hierfür sind zwei Filter von je 2.4 m. Höhe und 1.2 m. Durchmesser eingebaut', which means: 'For this purpose two filters of each 2.4 meters depth and 1.2 meters diameter are built in'. Also in the same latter paragraph he uses the adjective 'hoch' in the sense of 'thick': 'Permutite in ca. 70 cm hoher Schicht', which means; 'Permutites in a layer about 70 cm thick'. Compare also this sentence from Roch's Baukunde: "An den Ecken der Blockhäuser, da wo zwei Blockwände zusammenstoszen, findet eine überkreuzung der Balken statt, bei welcher man die Balkan bis bu einer Tiefe *von 1/4 ihrer Höhe* mit einer Verkämmung oder einer anderen ähnlichen Verbindung versieht." which means; "At the corners of blockhouses (log houses), where two log walls come together, there occurs a crossing of the beams, in which case one provides the beams with a comb mortise or other similar mode of joining to the depth *of one fourth of their thickness*".

'über'—preposition governing dative case where simple location is expressed, but the accusative case where limit of motion is expressed. Here it governs its object 'Oberfläche' in the dative case, and indicates location only. It has several common meanings, as 'above', 'over', 'across', 'beyond', 'on top

of', and the context must determine which is the most accurate translation. Here it means 'over' and implies 'on top of the whole surface'. This meaning is frequent in German, in cases where there can be no slightest doubt as to the immediate contact of the upper object with the one below. Compare Roch, Baukunde, p. 63: "Als Hauptregel für das Ansetzen eines guten Verbandes gilt, dass die Stoszfugen *in zwei übereinanderliegenden Schichten* nie aufeinander stehen dürfen", which means: "As chief rule for the making of a good bond (in masonry) is maintained, that the vertical joints in two layers lying upon one another, must never come to stand immediately above one another". Again p. 54; "Ist der Boden ganz weich, *so legt man über den ganzen Bauplatz eine Betonschicht*", which means: "If the ground is quite soft, one lays a layer of cement over the whole building space." Or again p. 73: "Die Verstärkungen der Bauhölzer endlich werden am zweckmäszigsten in der Weise ausgeführt, *dass man die Hölzer übereinander, nicht nebeneinander*, anordnet, da ja die Tragfähigkeit eines Trägers in Beziehung auf den Querschnitt mit dem Quadrate der Höhe aber nur mit dem einfachen Verhältnis der Breite zunimmt, which means: "The strengthening of building timbers is best produced in this way, that the timbers are arranged on top of one another, and not side by side, since the carrying capacity of a girder with respect to its cross-section increases with the square of its vertical thickness and only in simple ratio to its breadth". Compare Johannes Walther, Geschichte der Erde und des Lebens: Speaking of the so-called biosphere, he says: "Sie ist über die Festländer und über den Meeresgrund wie ein bunter Teppich ausgebreitet, nimmt als Tundra, Wald, Sumpf, Rasen, Korallenriff, Fischschwarm, Tierherde, sehr mannigfaltige Forman an, etc.", which means: "It is spread out over the continents and over the sea-bottom like a gay carpet, and as tundra, forest, swamp, sod, coral reef, fish swarm, and animal herd, assumes very manifold forms.' Or again by same writer: "Indem sich so Schuttdecke über Schuttdecke ausbreitet, wandert eine vorher an der Erdoberfläche befindliche Schicht langsam in die Tiefe und erleidet dabei in der Regel sehr markwürdige Veränderungen." which means; "While thus layer of debris spreads out over layer of debris, a stratum formerly at the earth's surface slowly wanders down into the depths, and as a rule undergoes at the same time very remarkable changes". Examples could

be multiplied indefinitely. These are all examples in which there can be no question of the immediate contact of the superior with its inferior object. The word 'über' seems to connote lateral expansion or movement at a higher level, but never excludes that contact expressed by 'resting on top of', which I understand the phrase 'über der Oberfläche' to mean in the paragraph in question.

'der'—def. art. fem. sing. dative case, modifies 'Oberfläche'; means 'the'.

'Oberfläche'—noun, fem. sing. dative case, object of preposition 'über'; means 'surface'.

'der'—def. art. fem. sing. genitive case with 'Permutitschicht'; means 'of the'.

'Permutitschicht'—noun, fem. sing. genitive case, modifies Oberfläche'; means 'permutite layer'.

'angebracht—perfect participle of the verb 'anbringen' (= to place or arrange); used here as a mere predicate adjective expressing state or condition; not a true passive voice; means 'placed' or 'arranged'.

'ist'—third person sing. present indicative of the verb 'sein' (= to be); agrees with its subject 'das'; means 'is'.

'das'—def. art. sing. neut. nominative case, modifies 'Sandfilter'; means 'the'.

'Sandfilter'—noun, sing. neut. nominative case, subject of 'wird—ersetzt'; means 'sand-filter'.

'wird'—third sing. present indicative of 'werden' (= to become); used as auxiliary with the perfect participle 'ersetzt' to form a true passive voice in the present tense; translated in English by 'is'.

'unter'—preposition governing objects in dative case when simple location is expressed, and in the accusative case when limit of motion is expressed; here it governs 'Umständen' in the dative case; means 'under'.

'manchen'—demonstrative adjective, dative plural, agreeing with 'Umständen' which it modifies; means 'many'.

'Umständen'—dative case plural of the noun 'Umstand'; object of 'unter': means here 'circumstances' or 'conditions'.

'besser'—comparative degree of the adverb 'wohl' and modifies the verb 'ersetzt': means 'better'.

'durch'—preposition governing accusative case; its object is 'Kalksteinfilter'; with passive voices it denotes means; here means 'by means of', or may be rendered by 'by' in the sense of 'by means of'.

'ein'—indef. art. sing. neut. accusative case to agree with 'Kalksteinfilter' which it modifies; means 'a'.

'Kalksteinfilter'—noun, neut. sing. accusative case, object of the preposition 'durch'; means 'lime-stone filter'.

'ersetzt'—perfect participle of the verb 'ersetzen' (= to replace by substitution); here used with 'wird' to form a passive voice: 'wird—ersetzt' means 'is replaced'.

'z. B.'—initials of the phrase 'zum Beispiel', and means 'for example'.

'bei'—preposition governing dative case; its object is 'Wässern'; here means 'in case of'.

'eisenhaltigen'—descriptive adjective, plural dative case, modifies 'Wässern'; means 'iron-containing'.

'und'—coordinating conjunction, connects the two adjectives 'eisen haltigen' and 'sauren'; means 'and'.

'sauren'—descriptive adjective, plu. dat. mod. 'Wässern', means 'acid'.

'Wässern'—plur. dative noun, object of 'bei'; means 'waters'.

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'Diese'—demonstrative adj. fem. sing. nominative case, agreeing with 'Anordnung', which it modifies; means 'this'.

'Anordnung'—noun, fem. sing. nominative case, subject of 'soll weiter verhindern'; means 'arrangement'.

'des'—def. art. neut. sing. genitive case, agreeing with 'Sand- oder Kalksteinfilters' which it modifies; means 'of the'.

'oberen'—descriptive adjective, weak declension, neut, sing. genitive case and modifies 'Sand oder Kalksteinfilters'; means 'upper'.

'Sand-'—the hyphen indicates that this word is to be compounded with '-filters' making it in full 'Sandfilters'; noun, neut. sing. genitive case, dependent upon 'Anordnung'; means 'sandfilter'.

'oder'—coordinating conjunction, connecting 'Sand-' and 'Kalksteinfilter'; means 'or'.

'Kalksteinfilters'—noun of same construction and use as 'Sandfilters; means 'limestone filter'.

'soll'—third person, sing. pres. indicative of the auxiliary verb of mode 'sollen', to agree with its subject 'Anordnung'. This verb has varying shades of meaning, among them the one here used; means 'is intended to' or 'is said to'.

'weiter'—comparative degree of the adverb 'weit' (= far); means 'further', *i. e.* in addition to something already mentioned. Here it means that the 'sandfilter' not only acts as a filter to remove foreign matters from the water, but in addition to that acts as a hindrance to mechanical disturbance of the specifically light permutites by back washing.

'verhindern'—verb, transitive, active, infinitive mode, depending upon 'soll': means 'prevent'; its object is the whole substantive clause introduced by the conjunction 'dasz'.

'dasz'—a subordinating conjunction used to introduce the substantive clause, which is the object of 'verhindern': means 'that', but may be rendered idiomatically in English so as to disappear entirely; the effect of such conjunctions is to put the verb at the end of the clause as here, where 'abgeschlemmt werden' is so placed.

'bei'—prep. governing dat. case, as above: its object is 'Rückspülungen': means 'in case of'.

'Rückspülungen'—noun, fem. plu. dative case, object of 'bei': means 'backwashings'.

'die'—def. art. masc. plu. nominative case, modifies 'Permutite'; means 'the'.

'spezifisch'—adverb modifying the adjective 'leichten': means 'specifically' and refers to the low specific gravity of the Permutites.

'leichten'—descriptive adjective, weak, masc. plu. nominative case, modifies 'Permutite'; means 'light', *i. e.* light in weight.

'Permutite'—noun, masc. plu. nominative case, subject of 'abgeschlemmt werden': means 'permutites'.

'mechanisch'—adverb of manner, modifying 'abgeschlemmt'; means 'mechanically'.

'abgeschlemmt'—perfect participle of the verb 'abschlemmen' (= to wash away, as fine mud or silt is washed away by currents of water); here used with the auxiliary verb 'werden' to form a true passive voice.

'werden'—third person plural present indicative of the verb 'werden' (= to become); used to form the passive voice of 'abschlemmen'. The phrase 'abgeschlemmt werden' literally means 'are washed away'.

Plaintiff's Exhibit 52, Comparative Arrangement.

(Stipulated from Permutit v. Wadham.)

Die Permutitschicht lagert auf feinem, nach der Tiefe zu gröber

The permutite layer lies on fine, towards the bottom coarser.

werdendem Sande. Nach oben hin wird sie am besten von einem

becoming sand. At the top becomes it best by a
Facing upwards is (Fem.)

Sanfilter abgeschlossen, das in zirca 1/3 bis 1/2 m. Höhe über

Sand-filter finished off which with about 1/3 to 1/2 m. thickness over
closed off in

der Oberfläche der Permutitschicht angebracht ist. Das Sandfilter

the surface of the Permutite layer arranged is The sand-filter

wird unter manchen Umständen besser durch ein Kalksteinfilter

becomes under many conditions better by means of a lime-stone filter
is circumstances

ersetzt, z. B. bei eisenhaltigen und sauren Wässern.

replaced, for example in case of iron-containing and acid waters.
substituted

Diese Anordung des oberen Sand— oder Kalksteinfilters soll weiter

This arrangement of the upper sand— or lime-stone-filters is intended further
is said

verhindern, dasz bei Rückspülungen die spezifisch leichten Permutite

to hinder that in case of backwashings the specifically light permutites
to prevent

mechanisch abgeschlämmt werden.

mechanically washed away become

Plaintiff's Exhibit 37, Haas Manuscript Translation Gans' Article.

(Stipulated from Permutit v. Wadham.)

[Chemische Industrie, vol. 32, no. 8 (632), pp. 197-200, April 15, 1909]

On the Technical Significance of the Permutits

(*Artificial Zeolitic Compounds*)

by

Dr. R. Gans,
Director of the geonomic laboratory of the Königl. Geologische Landesanstalt in Berlin.

The permutits—which are produced, according to my proposal,[1] by the fusing of aluminum silicates or aluminum minerals, with admixture of quartz if required, with alkaline carbonates and the treatment of the fused mass with hot or cold water—must, in order to be serviceable for technical purposes, be of granular or laminar, easily permeable nature. For this reason the above components are fused together in definite proportions. An excess of alkaline carbonate should be avoided, otherwise more or less slimy products are developed. Part of the soda chiefly employed can be advantageously replaced by potash or, more cheaply, by potassium feldspar or other stones containing potassium. In consequence thereof the grains of the zeolite become larger and more porous, and a higher reactivity of the permutits is attained.

The zeolites produced in this manner each contain, after the combination by fusing, for every 2 to 4 molecules of SiO_2 one molecule of Al_2 with O_3 and one molecule of Na_2O (or K_2O) and a more or less considerable water content (20 to 30 per cent).

The zeolites—also called aluminate-silicates by me—contain their bases attached to the alumina in the molecule in the form of alkalis and alkaline earths, and readily exchange them on contact with salt solutions of other bases. The exchangeability extends to a more or less considerable part of the basic content according to the size of the grains of the permutit.

The higher the basic content is, the greater is the exchanging power of the permutits. Now, since they always contain

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[1] R. Gans, Zeolithe und ähnliche Verbindungen, etc., Jahrbuch der Kgl. Geolog. Landesanstalt, Berlin, 1905, pages 179-211.
R. Gans, Konstitution der Zeolithe, ihre Herstellung und technische Verwendung, *ibid.*, 1906, pages 93-94.

one molecule of Na_2O (or K_2O) to one molecule of Al_2O_3—or, in other words, the alumina content is determinative of the basic content—my efforts were directed toward increasing the alumina content as much as possible, in order at the same time to obtain also an increase in the basic content. Such an ideal zeolite should as far as possible correspond to the formula $2SiO_2 . Al_2O_3 . Na_2O + 6H_2O$, which composition was really approximately obtained.

On the ready exchangeability of their bases depends the applicability of the zeolites for scientific and technical purposes. A further advantage of the zeolites lies in the fact that all their salts, even those of the alkalis, are insoluble in water.

The range of applicability of the zeolites is very considerable and is by no means limited to simple exchange. In the following brief survey individual examples are selected to illustrate the varieties of application that are based on the different processes.

PROCESS I.

Removal of undesired bases from solutions by means of simple exchange, the salts incidentally formed being soluble in water.

If a filter layer of about 50 to 100 centimeters is constructed of a sodium zeolite, which may be constituted in accordance with the formula $2SiO_2 . Al_2O_3 . Na_2O + 6H_2O$, and if a dilute solution of calcium chloride, for example, is caused to flow slowly over it, there is developed a calcium zeolite and concurrently NaCl, which passes off in the filtrate:

Formula I (*a*):

$$2SiO_2 . Al_2O_3 . Na_2O + CaCl_2 = 2SiO_2 . Al_2O_3 . CaO + 2NaCl$$

By washing with NaCl solutions the calcium zeolite can again be changed back to a sodium zeolite. This regeneration process takes place in a manner similar to that above:

Formula I (*b*):

$$2SiO_2 . Al_2O_3 . CaO + 2NaCl = 2SiO_2 . Al_2O_3 . Na_2O + CaCl_2$$

Both processes attracted the attention of many zeolite investigators, and the conditions under which they take place most favorably have been determined by numerous researches.

PROCESS II.

Removal of undesired salts from solutions, not merely the base but also the acid being removed, and the salts incidentally formed being insoluble in water:

Formula II, 1st example:

$$2SiO_2 . Al_2O_3 . CaO + Na_2CO_3 = 2SiO_2 . Al_2O_3 . Na_2O + CaCO_3$$

Formula II, 2d example:

$2SiO_2 . Al_2O_3 . BaO + CaSO_4 = 2SiO_2 . Al_2O_3 . CaO + BaSO_4$.

Formula II, 3d example:

$2SiO_2 . Al_2O_3 . Ag_2O + 2NH_4Cl = 2SiO_2 . Al_2O_3 . (NH_4)_2O + 2AgCl$.

We observe that, in consequence of the insolubility of the salts that are formed, the undesired salt disappears from the solution completely.

Rümpler was the first to call attention to this variety of the exchange process.[1]

Process III.

Development of contact surfaces by means of single and double exchange for the precipitation of bases from solutions:*

Formula III, 1st example:

$2SiO_2 . Al_2O_3 . Na_2O + SnCl_2 = 2SiO_2 . Al_2O_3 . SnO + 2NaCl$.

Formula III, 2d example:

(*a*) $2SiO_2 . Al_2O_3 . CaO + MnCl_2 = 2SiO_2 . Al_2O_3 . MnO + CaCl_2$.

(*b*) $2SiO_2 . Al_2O_3 . MnO + CaMn_2O_8 = 2SiO_2 . Al_2O_3 . CaO + MnO . Mn_2O_7$

(*c*) $2SiO_2 . Al_2O_3 . CaO + MnO . Mn_2O_7 + 2MnH_2(CO_3)_2 = 2SiO_2 . Al_2O_3 . CaO + 5MnO_2 + 2H_2O + 2CO_2$.

The process (example 1) serves to precipitate gold from dilute solutions. A large surface of active stannous oxide† is obtained, which precipitates the gold, not by direct exchange, but by the catalytic action effected by the SnO.

The second example gives us an explanation of the reaction of the removal of manganese from waters. In this process the manganese compound $MnO . Mn_2O_7$ that is formed remains firmly adherent within and upon the grains of zeolite, so that a large surface is available for the exercise of the catalytic action, with which an oxidizing action is also connected in this case.

Process IV.

Removal of free alkalinity from solutions.

The zeolites are capable of taking up free alkalinity from dilute solutions and of giving it up again on contact with slightly acid liquids.

The above processes can, however, serve not only for the purposes named, but permit of numerous variations.

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[1]Internationaler Kongress für angewandte Chemie, Berlin, 1903, vol. 3, pages 59-69.

*[Translator's Not. *Austauch* is a misprint for *Austausch*.]

†[Translator's Note. *Zinoxydul* for *Zinnoxydul*.]

Thus, for example, the process no. I effects the concentration of a base contained in the most dilute solution, and does so, to begin with, in insoluble form by enrichment within the zeolite itself. Since the base, however, can be displaced out of the zeolite again by exchange by means of a concentrated salt solution, we obtain it in solution also, in consequence of this return exchange, and that, too, in a considerably more concentrated (solution) than before.

From formula III, example 2*b*, we see that the zeolite containing manganous oxide takes up within itself quantitatively not only the calcium, but also the manganese of the $CaMn_2O_5$. This process can be utilized for the purpose of making a (supply of) water-germ-free. If we treat a (supply of) water with a dilute $CaMn_2O_5$ solution, we are in a position, after subsequent sterilization, to rid the water again quantitatively of the disinfectant ($CaMn_2O_5$) and to make it potable, by simple filtration over the above manganous oxide zeolite.—The zeolite thereupon contains higher manganese oxides in consequence of the oxidizing action of the $CaMn_2O_5$. The means of regeneration consists, in the case of this process, of $MnCl_2$ solution, by means of which the higher manganese oxides are transformed into those of lower stages of oxidation, which are again capable of absorbing $CaMn_2O_5$, etc. In this connection I wish to call attention also to the fact that the more frequently these oxidizing and deoxidizing processes are repeated* and the more manganese the zeolite takes up in these processes from $CaMn_2O_5$ and $MnCl_2$, the larger are the quantities of germ-free water that the zeolite makes it possible to obtain.

Process I can thus serve besides for the convenient and almost waste-free production of the salts of one and the same base and acid. By means of the filtration of a potassium chlorate or perchlorate solution over an ammonium zeolite I obtained pure ash-free ammonium chlorate or perchlorate.

In consequence of the action of KCl or K_2SO_4 solution upon a sodium zeolite there resulted a potassium zeolite, from which latter almost chemically pure potassium carbonate was obtained by the action upon it of an ammonium carbonate solution and concentration of the filtrate by evaporation.

The possibilities of the application of the zeolites are by no means exhausted by the above examples. Several of their technical applications are to be discussed in greater detail in what follows.

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*[Translator's Note. The auxiliary *werden* is omitted.]

In the sugar industry.

Harm and Rümpler were the first to propose a technical utilization of the exchanging power of natural and artificial zeolites, namely in the sugar industry. The process concerned in that connection consists in the replacing of the potassium of the sugar juices by calcium, since it had been determined by scientific experiments that calcium salts operate to form molasses considerably less than potassium salts. The process is thus a pure exchange process and is carried out by filtration of the sugar juices containing potassium over a calcium zeolite and regeneration of the latter, after its saturation with potassium, by means of calcium chloride solution.

But the exchanging power of the zeolite silicates of Harms and Rümpler was not adequate, so that technical utilization did not result from their proposals.

The same experiments with the permutits,[1] which have considerably greater exchanging power, have yielded the result that, in addition to a clarifying of the sugar juices and the removal of the largest part of the potassium, an increased power of crystallization of the sugar juices and molasses treated was obtained. The difficulty in boiling and the foaming that were prophesied and feared by a number of experts in consequence of the removal of the potassium did not occur. The experiments are to be continued in the next campaign, and probably in another form than that proposed by Harm and Rümpler.

By displacement of the potassium of molasses by sodium I was able to attain a greater palatability and a molasses less harmful for fodder purposes.[2]

The introduction of the process into the sugar industry will depend essentially upon whether considerable economic advantages can also be secured by means of it. In order to cover the costs of the process it will be requisite, in my opinion, in addition to an increased yield of sugar, to succeed in obtaining in any form, possibly one suitable for fertilizing purposes, the potassium salts extracted from the sugar juices by the exchange process.

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[1]H. Lührig and W. Becker, Ueber das Verhalten künstlicher und natürlicher zeolithartiger Körper, Chem. Zeitung, 1908, no. 44, page 532.
R. Gans, Ueber die Klassifikation der zeolithischen Silicate, Zentralblatt für die Zuckerindustrie, vol. 16, no. 14.

[2]R. Gans, Verbesserung von Trink- und Gebrauchswasser, etc., Ver. der Deutschen Zueckerindustrie, 1907, vol. 57, no. 613.

In the technique of water purification.

The permutits appear particularly suitable for the softening of water and the removal of manganese (or iron) therefrom.[3]

(a) *Softening:*

The process in question in this connection is in its simplest form a pure exchange process, by means of which the calcium and magnesium of the water are taken up by the zeolite and sodium is given off to the water:

$$2SiO_2 . Al_2O_3 . Na_2O + CaH_2(CO_3)_2 = 2SiO_2 . Al_2O_3 . CaO + Na_2H_2(CO_3)_2$$

$$2SiO_2 . Al_2O_3 . Na_2O + CaSO_4 = 2SiO_2 . Al_2O_3 . CaO + Na_2SO_4$$

The regeneration is accomplished by washing with a solution of common salt the zeolite that is saturated with calcium or magnesium, in consequence of which process there is again formed a sodium zeolite which takes charge of the softening of new quantities of water. Various filters of this kind are already in use, partly for the production of soft water for boiler supply purposes, partly for laundries.

The filter plants in question are notable for the simplicity of their arrangement.

The softening is complete even in the case of cold water.

The equipment consists of an iron or wooden filter. The depth of the permutit layer is determined according to the degree of hardness of the water in question and the speed of filtration. The efficiency is the greater, the more slowly the water flows through the permutit filter and the finer the grains of the permutit are.

The permutit layer rests upon fine sand which grows coarser toward the bottom. In the upward direction it is best terminated by a sand filter, which is applied to a depth of about ⅓ to ½ meter over the surface of the permutit layer. The sand filter is more suitably replaced, under various circumstances, by a limestone filter, in the case of ferriferous or acid waters, for example. This arrangement of the upper sand or limestone filter is further intended to prevent the permutits, which have a lower specific gravity, from being mechanically washed away in case of back washes.

Example: In a Berlin factory there is a plant for the softening, 10 hours each day, of 35 to 40 cubic meters of boiler supply

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[3]R. Gans, Verbesserung von Trink—und Gebrauchswasser, etc., Mitteilungen a. d. Kgl. Prüfungsanstalt für Wasserversorgung und Abwässerbeseitigung, Berlin, 1907, no. 8.

water of about 10 German degrees of hardness. For this purpose 2 filters are built in each of 2.4 meters height and 1.2 meters diameter. Each filter contains about 700 kilograms of centrifugally dried (450 to 500 kilograms of air dried) permutit in a layer about 70 centimeters deep. There is always only one filter in operation. Within the first 4 to 5 days the filter supplies water of 0 degrees of hardness, after which the hardness gradually rises until the 7th day, reaching 4.5 to 5 degrees of hardness. It is thereupon regenerated, with a solution of 150 to 180 kilograms of common salt, denatured with charcoal, in 900 to 1000 kilograms of warm water, which solution is caused to flow slowly over the filter. Finally the filter is rinsed out until the disappearance of the chlorine reaction, whereupon it is ready for further use.

In suitable cases, in the softening of water, the simple exchange process no. I may be advantageously combined with the process indicated under no. IV.

(b) *Removal of manganese or of iron.*

At Glogau, for the purpose of removing manganese, 450 kilograms of calcium zeolites, which rested in an iron tank of 0.95 square meter cross-sectional area in a layer about 0.6 meter deep, were converted according to process III, example 2, first into manganese zeolites by washing with manganous chloride solution and then back to calcium zeolites by means of calcium permanganate solution. The incidentally developed higher manganese oxides are firmly adherent mechanically within and upon the zeolite grains. They constitute a large surface, and in consequence of the catalytic action, with which an oxidation process is connected, they are able to effect a quantitative precipitation of manganous oxide salts, even when these are present in the greatest dilution.

Over this filter drinking-water that contained about 2 to 2.5 milligrams of MnO per liter was then passed at the high speed of 22 to 25 meters per hour. The largest part of the precipitated manganese is likewise deposited firmly upon the zeolite grains. Together with the manganese there are precipitated also the last traces of iron, which persistently remain in the water despite an excellently operating plant for the removal of iron.

This iron slime is removed daily by means of a brief rinsing by return flow.

When the higher manganese oxides have been converted into low stages of oxidation by means of the precipitated man-

ganous oxide—in other words, when the filter is exhausted—it is regenerated by means of a solution of $CaMn_2O_5$. This solution is caused either to flow slowly through the filter during the night or to ascend and descend slowly in the filter during interruption of operation, a quantitative absorption of the $CaMn_2O_5$ being thereby attained in both cases.

The manganese from the calcium permanganate and from the water continuously increase the manganese content of the filter *and thereby its power of removing manganese,* for all the manganese is converted into higher oxides in the regeneration.

Thus, for example, 80 cubic meters of water were freed of manganese by the filter at its first utilization. After about 12 regenerations, however, the power of removing manganese had already increased to 2400 cubic meters of water.

The filter supplies each hour about 23 to 24 cubic meters of water which is free from iron and manganese, clear as crystal, and of refreshing excellence of taste. The reaction is neutral, as before. The other constitutents of the water [and] its hardness remain unchanged. The costs in case of the employment of $CaMn_2O_5$ amount to about *0.4 pfennig per cubic meter.*

In case of the employment of potassium permanganate instead of the expensive calcium salt the cost amounts to about 0.15 to 0.25 pfennig per cubic meter. The $KmnO_4$ is either employed in commixture with $CaCl_2$ or is previously converted into $CaMn_2O_5$ by filtration over a special calcium zeolite filter. This arrangement has the purpose of obviating a taking up of considerable quantities of potassium on the part of the filter and a subsequent delivery to the drinking-water in consequence of exchange with the lime of the water.

The former method of removing the manganese from the water by direct exchange[1] I have abandoned in favor of this method of elimination, the action of which is prompt and in every respect unexceptionable.

The quantitative elimination of the last traces of iron from the water justify the hope that this permutit process can also be applied with like success to the removal of iron from water.

The processes enumerated above have been proposed by me thus far, and on the basis of the results of extensive preliminary experiments it is to be expected that they will to a greater or less degree find entrance into technical procedure. Other methods of application are being worked out.

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[1]R. Gans, Reinigung des Trinkwassers von Mangan durch Aluminat-silicate Chem.-Zeitung, 1907, no. 28.

Plaintiff's Exhibit 37, Haas Manuscript—Translation Gans'

But I hope, in addition, that not only technical chemistry will be able to make use of the zeolites, but that they will be of use also to theoretical and analytical chemistry in scientific tasks, especially in such cases in which the processes indicated lead to the desired end more quickly and more elegantly than those hitherto known.

Berlin, March 26, 1909.

[A. 2903.]

535 And on to-wit: the 1st day of November, A. D. 1929, there was filed in the Clerk's office the following Exhibits, to-wit:

536 DEFT'S EX. 18.

Filed Nov. 1-1929. Charles M. Bates, Clerk.

The Permutit Company

Town New York
Date 3/16/27

7909

To: Florida Filter Corporation

From: Sales Dept.

Subject: Gulf Refining Company, Port Tampa, Fla.

1. We replied to that part of your wire which read as follws:

"Mail us report on best recommendations for Gulf Refining Port Tampa based on last samples water sent you about February fifteenth and wire us nature of treatment and approximate cost apparatus and operating—Also Gulf here have several Wayne Domestics in filling stations sixteen by fifty four shells old downflow mineral two feet below top of shell and capacity very low do you recommend adding Permutit on present bed or rebuilding."

2. The analysis of the samples of water collected from well No. 1 and well No. 2 were sent to you under date of March 5, 1927. Our comments on these analyses at this time are given in the following:

3. The analysis of well water No. 2 indicated that economic treatment was impossible.

4. The analysis of well water No. 1 indicated that composition of that water supply was similar indeed to the composition of the water supply as analyzed under date of December 28, 1926.

5. For a lime soda treatment plant for well No. 1, or the other supply, the following chemical charges would apply:

5 lbs. of lime per M. Gallons

3½ lbs. of soda per M. gallons

¼ lb. alum per M. Gallons.

6. The effluent of the lime soda plant would be equivalent

to 10 grains actual, but for figuring a zeolite softener to follow, figure on an adjusted hardness of 20 grains.

7. The total solids after the Lime Soda—Zeolite treatment would be 1700 parts and will require about 50% blow-off for proper operation of their boilers.

8. As advised you in our wire, the estimates given previously still hold because there has been no change in any recommendations given, only to the extent that conditioning well water No. 2 is impossible. This information is given to you under remarks on analysis sheet sent to you under date of March 5, 1927.

537 9. The estimate on the lime soda plant of 3300 gallons per hour holds—see our estimate of 1/5/27.

10. However, the Zeolite Plant to follow can be figured on an adjusted hardness of 20 grains for this well water No. 1.

Capacity 20 grains, special soap test i. e. 9 drops in 20 c.c.
(Two (2)—4'6" Vert. Softeners by 7'10" in straight
One (1)—4' x 4' Steel Saturator Salt per regeneration 170 lbs.

Price	$2270.00
Freight	450.00

Engineer extra.

11. If aeration, iron removal and zeolite type of plant is preferred to the lime soda plant offered, our estimate of 1/22/27 still holds, complete, as it is based on the same quantity of water as this well No. 1. In fact, this will be a much cheaper plant to operate and is the one you should endeavor to interest them in actually purchasing.

12. Regarding the Wayne Domestic Softeners that the subject has installted in their filling stations in this case, as in all cases where competitive softeners are not giving results and we are called upon to give service, we are in favor of doing one of two things, i. e.

(a) Completely remodelling the plant—or—
(b) Having nothing to do with it.

13. In the case of these Domestic Units, if we were to sell them a partial refill, and they continue to have trouble, which in all probability would be due to the construction of the machine they would be operating, we in turn would be called upon to furnish the service of our engineer gratis. There is no profit in such work for either you or us, and we are better off to play the game "hands off."

14. However, if these people are seriously interested in securing results with the present units they now have, but

with our assistance, then send to us a completely filled out sketch showing the type of shell and pots; shall dimensions size of piping, strainer system, and information as to the water that is to be used, or a sample of that water supply.

15. We note from your wire that the subject's present softeners are 14" in diameter. We never knew they sold a unit of that size.

D. J. S.
Sales Department.

DJS:LJS

Endorsed: Filed Nov. 1, 1929. Charles M. Bates, Clerk.

538 DEFENDANT'S EXHIBIT #20.

* *(Caption.) * *

STIPULATION.

It Is Hereby Stipulated and Agreed by the parties hereto—subject to correction if error appear:

That the Techniche Rundschau Article entitled "Wasserreinigungs-Verfahren mit Permutit" was published on January 27, 1909, as a part of the supplement of Berlinger Tageblatt and that the photostatic copy thereof, identified as Defendant's Exhibit No. 24, may be received in evidence with the same force and effect as the original.

That the translation of said Techniche Rundschau Article, identified as Defendant's Exhibit No. 25, is a correct translation of said Techniche Rundschau Article of January 27, 1909.

That the exhibit marked for identification as "Defendant's Exhibit No. 27", is a printed copy of pages 721 and 722 of a publication, "The Practical Engineer", published June 4, 1909, the original of said publication being in the New York Public Library; and that said printed copy may be received in evidence with the same force and effect as the original publication.

That Gebrauchsmuster No. 341,512 was filed May 8, 1908, registered May 30, 1908, and the descriptive title set forth in said Gebrauchsmuster was published in the Patentblatt, printed publication, on June 17, 1908, and that a photostatic copy of said Gebrauchsmuster, identified as Defendant's Ex-

hibit No. 28, may be received in evidence with the same force and effect as the original.

539 That the translation of said Gebrauchmuster No. 341,512, identified as Defendant's Exhibit No. 29, is a correct translation of said Gebrauchmuster.

That Gebruachsmuster No. 313,671 was filed June 27, 1907, registered July 25, 1907, and the descriptive title set forth in said Gebrauchsmuster was published in the Patentblatt, a printed publication, on August 8, 1907, and that a photostatic copy of said Gebrauchsmuster, identified as Defendant's Exhibit No. 30, may be received in evidence with the same force and effect as the original.

That the translation of said Gebrauchsmuster No. 313,671, which translation is identified as Defendant's Exhibit No. 31, is a correct translation of said Gebrauchsmuster.

That the Feldhoff Article was published in the publication called "Centralblatt für die Zuckerindustrie" on September 7, 1907, and that the photostatic copy thereof, identified as Defendant's Exhibit No. 32, may be received in evidence with the same force and effect as the original.

That the translation of said Centralblatt Feldhoff Article, which translation is identified as Defendant's Exhibit No. 33, is a correct translation of said Centralblatt Feldhoff Article.

That the photostatic copy of the German Leister patent No. 211,064, of January 23, 1908, identified as Defendant's Exhibit No. 34, may be received in evidence with the same force and effect as the original patent.

That the translation of said German Leister patent No. 211,064, identified as Defendant's Exhibit No. 35, is a correct translation of said patent.

Thta the photostatic copy of the down-flow water softener identified as Defendant's Exhibit No. 36, illustrates the water softener complained of in *Permutit* v. *Harvey Laundry Company, et al.*, decided by United States District Judge

540 Hazel, and reported in 274 Fed. 937, and decided by the Court of Appeals for the Second Circuit, and reported in 279 Fed. 713.

That the photostatic copy of the down-flow water softener identified as Defendant's Exhibit No. 37, illustrates the water softener complained of in *Permutit* v. *Wadham, et al.*, decided by United States District Judge Tuttle, and reported in 294 Fed. 370, and decided by the Court of Appeals for the Sixth Circuit, and reported in 13 Fed. (2nd) 454, and decided

upon rehearing by said same Court of Appeals, and reported in 15 Fed. (2nd) 20.

That the photostatic copies of the four (4) upflow water softeners, identified as Defendant's Exhibits Nos. 38 and 39 respectively, illustrate the water softeners complained of in *Permutit* v. *Paige & Jones Chemical Company*, decided on a preliminary injunction motion by United States District Judge Knox, and not reported, and decided by the Court of Appeals for the Second Circuit on the injunction, and reported in 22 Fed. (2nd) 916.

That the District Judge in *Permutit* v. *Paige & Jones Chemical Company, et al.*, granted the preliminary injunction as to all of the said upflow water softeners illustrated in Defendant's Exhibits Nos. 38 and 39 respectively, and that the Court of Appeals in said case reversed the trial court and dismissed the preliminary injunction with respect to three of said four up-flow softeners, illustrated in Defendant's Exhibit No. 39 and sustained the injunction against the upflow softener illustrated in Defendant's Exhibit No. 38.

COOPER, KERR & DUNHAM,
Counsel for Plaintiff.
WILKINSON, HUXLEY, BYRON & KNIGHT,
Counsel for Defendant.

September 11, 1929.

541 Endorsed: Filed Nov 1 1929. Charles M. Bates Clerk.

542-548 (DEFENDANT'S EXHIBIT 21, Agreed English translation of German Patent Law, omitted per stipulation filed June 10, 1930. See index.)

549-550 (DEFENDANT'S EXHIBIT 22, Agreed English translation of German Law on protection of Gebrauchmuster, omited per stipulation filed June 10, 1930. See index.)

551-560 (DEFENDANT'S EXHIBIT 23, Langner testimony in American Chain Company case, omitted per stipulation filed June 10, 1930. See index.)

DEFENDANT'S EXHIBIT 24

461

4

DEFENDANT'S EXHIBIT 43-44

Jan. 27, 1909.

feines Oel und 8 bis 9 pCt. Kalk. Als Mineralöle, die Seifen ein sollen, eignen sich sehr gut die russischen feine, wie verwendet man Rüböl- oder Kottonöl; an Tierfette werden benutzt: schließlich noch

...re erhält man z. B. aus folgender Zusammen... ...sisten paraffinfreien Mineralöl, 10 Gewichtsteile ... 20 Gewichtsteile Kokosöl, 1 20 Gewichtsteile ... 10, 30 Gewichtsteile Talg und 3 Gewichtsteile ... Man bringt zunächst 1 250 Teile Rüböl mit ... Mineralöl im Kessel mit dem Kalk russischer ... offenem Feuer dies gemisch etwas über ... Darauf ... setzt den Kokosnußöl und der Natronlauge, wodurch ... Masse zum Verseifen kommt. Ist letzteres soweit erfolgt, ... Probe nach Belieben wie Seife schneiden kann, ... Rest des Mineralöls und das Palmkernöl zu beifügen, ... kocht gut durch, läßt drei Stunden stehen, nicht las... und rührt sie im Rührwerk bis zur gewünschten ... die man daran beurteilen kann, daß das Oel kurze, feine ... Das fertige konsistente Fett wird gewalzt oder geprißt. ... Zusammensetzungen sind unter der Bezeichnung *Toroli*...

...ergibt sich folgendes: 100 Teile Mineralöl, 100 Teile ... 80 Rüböl, 20 Teile Leinöl, 30 Teile Kalk — Oder man ... Rüböl, 10 Teile Talg und 20 Teile gebrochen ... feinen Wassermenge im Kessel zum Kochen ... Kalk gut mischt, nach und nach bei steigendem Feuer ... Talg rührt und kocht solange, bis das ganze ... einige Masse bildet. Die erhaltene Probe darf nicht ... das Kochen darf nur soweit getrieben werden, ... Proben sich in lange feine Fäden ziehen lassen. ... 50 Teile Wasser zu und bringt erneut zum ... am das Kochen nicht zu unterbrechen, gibt ... ab bis 800 Teile Paraffinöl je nach Dünnflüssigkeit ... durch kurze Zeit, läßt dann abklären und behandelt ... Weise.

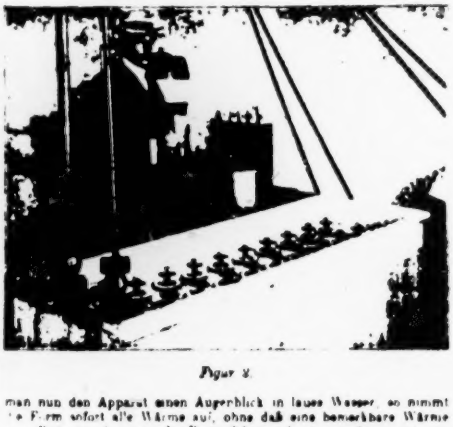
...gen, oder konsistentes Maschinenfett erstrecken sich ... genau richtige Abweichungen gegenüber meinen ... geringen Wassergehalt nicht über 3 pCt. ... Säure und Alkalizusatz ... Verunreinigungen. Schluß folgt.

Trinkbecher aus Eis.

...Begutachtung zweckmäßige Neuerung ist in der ... Trinkbecher nach dem Verfahren von *J. Fiedler* ... Das neue Trinkgefäß besteht aus einem ... gebildet aus Eis von 3 mm Wandstärke, welche ... hergestellt ist und zwecks bequemer ... mit einer besonderen Papierhülse ... besteht aus etwa 100 g Eis und 7 g Papier ... gewöhnlicher Sommer... ...Stunde zum ruhigen ... Becher, anwen...

...Becher, dessen Herstellung erläutert ist, in ... ist und dem äußeren Kern ... in deren Zwischen... ...raum eine vorher hineingegossene Wasser... ...menge den Becher bilden soll. Der ... hat unten eine Tauchglühlampe *d*, so ... daß das Wasser beim Einsenken des Kerne... ...nur ganz wenig hinaustritt. Wird der ... Apparat in eine Gefrierzelle gestellt, ... geht die Erhärtung gewöhnlich von ... aus nach innen zu, der Boden hierbei ... zuerst und schließt das untere ... andere Wasser in dem ... gelassen ... Becher ab. Darauf ... beginnt die Er... ...starrung der Wassergefäße ... erfolgend von oben nach unten am Kern ... anschließend fort und drückt das durch ... Volumenvergrößerung ausfließende ... Wasser sowie die Luft in die Tauch... ...glühlampe, wo ... ringförmig ... Boden... ...wölbeartig ausbildet und ... einem ... gleichzeitig gebildeten Kommunikationsgefäß ... wird. Das grobe Kraftwerk ... sich ... Wasser bei der Erhärtung ausdehnt ... Volumen... ...

...man muß der Becher hell und trocken herausgenommen werden. Hierfür wird der Apparat angewandt, die Form sich erwärmt und der Kern sich langsamer und geringer als den des Eises aufnehmen, so daß die Ausdehnungen folgen. In der Regel werden die Formen aus einer Metall oder einer Metallegierung ... Kern aus Porzellan ... ein spezielles und ausgewähltes Material ... Wärme ... Ausdehnungskoeffizienten hergestellt. Tauch...



Figur 2.

...man nun den Apparat einen Augenblick in laues Wasser, so nimmt die Form sofort alle Wärme auf, ohne daß eine bemerkbare Wärme zum Becher kommt, die Form dehnt sich nun genügend aus, so daß man den Becher am Kern sofort herausziehen kann. Damit der Becher vom Kern abgedrückt werden kann, sind die gleichenartig gebohrten, in dem die Tauchlötung *d* konstruktiv entsteht, mehrere Stange *f* und Knopf *g* angebracht. Dieser Kolben drückt beim Herunterstoßen gegen den Boden und löst so den Becher. Die Becher in wagrechter Stellung *i* führen den Kolben wieder in seinen Hochstand zurück. Die ganze Manipulation des Heraus- und Herabnehmens kann sehr schnell geschehen, wie Uebung es zuläßt, in einigen Sekunden. Der Becher kommt noch unter 0° C, also trocken heraus, der Kern bleibt sehr kalt, so daß nur die dünne Form eine Temperaturschwankung von kalt bis warm macht. Statt mit mechanischem Druck kann der Becher auch mit Luftdruck abgeblasen werden.

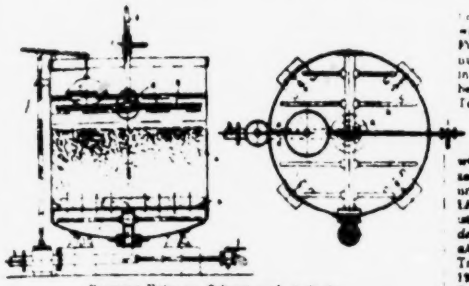
Das obige Verfahren wird als „nasses Verfahren" bezeichnet, weil die Form einmal in eine Gefrierflüssigkeit und andermal in eine Wärmeflüssigkeit getaucht wird. Es besteht noch ein „trockenes Verfahren", wobei die Form von einem Mantel umschlossen wird, durch den das Gefrieren durch direkte Verdampfung der verflüssigten Gase bewerkstelligt und die Form nachher elektrisch heizt, um den Becher herauszubekommen. Hierbei bleibt somit die Form am Platz und hat man nichts mehr zu tun, als die Form mit Wasser zu füllen und den Becher am Kern herauszusehen.

Fig. 2 zeigt einen Refrigerator für Eisbecher-Apparate nebst Zubehör in der Anlage *Nymph* in Schwemsien, die zum Verkauf von erfrischenden Getränken eingerichtet ist. Die maschinelle Einrichtung besteht in der Hauptsache aus einem Elektromotor, der durch Deckentransmission eine Schwefligsäure-Kältemaschine und die Rührvorrichtungen antreibt, sowie aus zwei Refrigeratoren und einem Kühlschrank. Die Anlage kann 300 Becher in der Stunde ausliefern, während der Kühlschrank einen Aufbewahrungsraum für 450 Becher bietet, so daß bei starker Frequenz in der Stunde bis 500 Becher verbraucht werden können. Die hygienischen Vorteile dieser von der *Nederlandsche Ijsbeker Maatschappij Nymph* fabrizierten Becher liegen darin, daß jeder nur einmal benutzt werden kann.

Wasserreinigungs-Verfahren mit Permutit.

Als neuestes Verfahren auf dem Gebiete der Reinigung bezw. Weichmachung von Wasser, das z. B. zur Kesselspeisung und für Aufbereitung von Fabrikationswasser für Färbereien, Bleichereien, Lederfabriken, Zellstoffabriken usw. verwendet werden soll, ist das von Dr. *R. Gans*, Vorsteher des Laboratoriums für Bodenkunde der Königl. Geologischen Landesanstalt in Berlin, erfundene Permutit-Verfahren zu nennen. Dasselbe beruht auf der Verwendung von Natrium-Natrium-Silikat $Na_2Si_2O_5$, d. i. ein basisches Aluminat-Silikat, das ... Zeolithe, das sich künstlich in körniger oder glasiger ... der Form *A. Le Chatelier* ... Wasser gelöst ... Natronlauge ... darauf den Kalk und die Magnesia auf ... Verfahren ... viel einfacher als im bisherigen, weil

DEFENDANT'S EXHIBIT
TECHNISCHE RUNDSCHAU



Permutit-Filter im Schnitt und Aufsicht

Aber es braucht nun nicht als unbrauchbar fortgeworfen zu werden, sondern es tauscht jetzt umgekehrt ebenso bereitwillig den Kalk- bezw. Magnesiagehalt wieder gegen Natron aus, wenn man es mit einer Kochsalzlösung übergießt. Das Permutit ist dann regeneriert, in seinen anfänglichen Zustand zurückversetzt und übt nun von neuem seine reinigende Wirkung aus.

Die Filterkonstruktion ist variabel und richtet sich nach der Zusammensetzung des Wassers. In einem, beispielsweise unter in Schutt und Asche dargestellten eisernen oder hölzernen, zylindrischen, unten kon. zu nutzenden Filtergefäß a ist das Permutit eingelagert. In dem Konus liegt ein perforiertes Blech b als Siebboden, darauf eine Schicht aus grobem Kies, dann folgt eine Schicht aus feinem Kies, darauf liegt die Permutitschicht. Diese wird mit einer lockeren

[illegible] gedeckt, über man kann nach Belieben einen Rost [illegible] mit grobem belassen, indem man die Geschwindigkeit des Wasserdurchflusses durch das Filter regulieren. Ohne Rost, wie beim Kalk-Sodaverfahren, tritt hier nicht [illegible] fällt die bei letzterem üble Belästigung durch Kalkstaub [illegible] Natrium durch den Umgang mit Soda und dergl. vollständig vermieden wird, war das billige dreiatomarste Kochsalz [illegible]

In der Berliner Fabrik befindet sich eine solche Anlage [illegible] ununterbrochenen Enthärtung von 35 bis 40 cbm Kesselwasser von 10 deutschen Härtegraden. Dazu sind auf [illegible] Filter von je 2,4 m Höhe und 1,2 m Durchmesser, von denen nur eins in Betriebe ist. Jedes enthält etwa 700 kg Natrolith in einer Schicht von 2,5 cm Höhe. Die Durchflußgeschwindigkeit beträgt 65 bis 70 l minutlich. Innerhalb der ersten [illegible] Tage liefert das Filter ein Wasser von 0 Härtegraden, [illegible] Härte allmählich zunimmt, und zwar am siebenten Tage bis 5°. Dann wird das Filter abgestellt und mit einer Lösung von 140 kg Kochsalz in 900 bis 1000 kg Wasser regeneriert, während dreier Monate mit permutiertem Wasser gespeist. Nach einem Bericht des Lieferanten keine Spur von Kalk und erwies sich auch nach jeder übrigen Richtung als [illegible]. Literatur über Zeolithe im allgemeinen und Permutite im besonderen ist zu nennen: *H. Ossa*, „Konstruktion der Zeolithe" usw. *Königl. Preußischen Geologischen Landesanstalt* [illegible] *Abhandlungen*, Berlin 1908, S. 63 bis 84. — Derselbe, „Reinigung von Trinkwassers von Mangan durch Aluminatsilikate" (Chem. [illegible] Zeitung 1907, Nr. 23. — Derselbe, „Verbesserung von Trinkwasser [illegible] Gebrauchswasser für häusliche und gewerbliche Zwecke durch Aluminatsilikate oder künstliche Zeolithe". *Mitteilungen aus der Königl. Prüfungsanstalt für Wasserversorgung und Abwasserbeseitigung zu Berlin* 1907, Heft 8.

Gesteinsbohrmaschine mit 24 Bohrern

Die nebst abgebildete Gesteinsbohrmaschine zeichnet sich durch ihre eigenartige Anordnung und die gleichzeitige Verwendung von 24 Bohrern aus. Der die 24 Bohrköpfe aufnehmende Hauptkopf hat 2,43 m Durchmesser und ist aus Temperstahl. Der Betrieb erfolgt mit Druckluft, und zwar arbeiten die 24 Bohrer vollständig unabhängig voneinander, da jeder Bohrer seinen eigenen Antrieb und getrennte Druckluftzuleitung hat. Jeder Bohrer macht 400 Umdrehungen in der Minute, der ganze Spindelkopf macht [illegible]

24-spindelige Gesteinsbohrmaschine.

dichter Schicht feiner Hornwolle bedeckt, welche mittels eines perforierten, perlonierten Leinwandüberzuges locker festgehalten wird. Das [illegible] wird durch das Aufsatzrohr d für das gereinigte Wasser. Das Rohwasser tritt durch ein vom Schwimmer e im Reinwasserbehälter bei sinkendem Niveau in die unterste, das Permutitfiltergefäß mündende Rohrleitung f in ein oben perforiertes Rohr c. Aus das Wasser in gleichmäßiger Verteilung durch das Sieb in die Permutitschicht tritt.

Die Höhe der Permutitschicht im „Filter" richtet sich nach der Durchflußgeschwindigkeit des Wassers und dessen Härte und ist durch Erfahrung auszuprobieren. Die Breite der Schicht richtet sich nach der verlangten Leistung an Reinwasser. Zum Zweck der Regeneration wird eine 15 bis 20prozentige Lösung von mit Holzkohle [illegible] Kochsalz in warmem Wasser hergestellt und in ein [illegible] grobes Gefäß gepumpt, das sich über dem Filter befindet. Nachdem alles Wasser von dem Filter abgelaufen ist, läßt man die Lösung durch Öffnen des Hahnes f und des geschlitzten Rohres h darauf [illegible] und [illegible] einwirken, während man es unterdessen hinausgehen läßt, welches durch Hahn i austritt. Zum Schluß wird die nun halbstarke Lauge abgelassen und das Filter mit Wasser durchgespült, bis dieses nicht mehr auf Kalk und Kochsalz reagiert. Die Regenerierung wird entweder in der Nachtpause vorgenommen oder es werden zwei Filter zum Wechselbetriebe aufgestellt. Das zu reinigende Wasser wird bis auf 0° Härte herunter

Minute eine Umdrehung, wodurch der entsprechende [illegible] Bohrer erzeugt wird. Das beim Bohren ausfallende [illegible] wird durch eine Conveyoranlage nach dem der Maschine angebauten (siehe Bild) Wagen befördert. Der Kraftbedarf [illegible] eine Länge von 7 m aufweisenden Maschine beträgt 300 [illegible] eine Erfindung der Amerikaner *F. Perry* und *S. Proctor*.

Versuche mit Straßenbahnwagen.

Interessante Versuche über die wirtschaftlichen Verhältnisse [illegible] Verwendung von kleinen und großen Straßenbahnwagen [illegible] Anregung in den Vereinigten Staaten von *H. Parker* angestellt. Auf einer Linie hat er 30 je 1,81 Personen fassende Wagen mit 28 bis 30 t Gewicht verkehren, auf einer zweiten Linie gegen 50 offene Sommerwagen (je 10 bis 12 Bänke und 72 je 7 Bänke geschlossene Winterwagen). Für die erste Linie betragen die Kosten für Gleise, Kraftstation, Wagenhaus und Wagen 8,00 $, für die andere mit den kleinen Wagen 6,00 $, also für letztere rund [illegible] Wagenzahl weniger. Die jährlichen Kosten für Kraft, Unterhaltung und Abschreibung sind auf der Linie mit großen Wagen [illegible] für die mit kleinen Wagen 319 107 $, also ebenfalls [illegible] Dabei ist zu berücksichtigen, daß [illegible] rollende Masse [illegible] keineswegs voll ausgenutzt ist, da insbesondere die Sommerwagen [illegible] großen Teil des Jahres vollständig vom Betriebe ausgeschlossen [illegible]

563 DEF. EX. #25.

Agreed Translation.

Jan. 27, 1909.

Technische Rundschau

Supplement of Weekly Issue of the "Berliner Tageblatt"

Water Treatment with Permutite

The newest method to be adopted for the treatment of water, especially the softening for indusrial purposes, as in dyehouses, bleacheries, tanneries and cellulose factories is that of Dr. R. Gans, Director of the Laboratory for "Bodenkunde der Koenig Geologischen Landesanstelt" in Berlin, the discoverer of Permutite. It is especially simple and depends upon the use of Natrolite ($NA_2Al_2Si_3O_{10}$-$2H_2O$), i. e. a basic aluminium silicate of the zeolite group, which can be synthetically produced in granular or leaflet forms, and which has been introduced into the trade as "Permutite" by the firm of J .D. Riedel A.-G. Berlin. If one allows a water containing lime and magnesia to flow thru a Permutite filter, the Permutite gives up its sodium and substitutes therefor the calcium and magnesium. The method is much simpler than those heretofore used, because no chemicals need be added to the water. The insoluble Permutite exchanges with the water the calcium or magnesium for its sodium, as long as there is lime in the water and sodium in the Permutite. When the Permutite is exhausted the treating action of the filter ceases and the material remaining has a composition of chabasite Ca Al_2 Si_3 O_{10}-$2H_2O$. But it is not necessary to discard this as uselss, for it will readily exchange its calcium and magnesium content reversibly with sodium when it is treated with salt solution. The permutite is thereby regenerated, returns to its original condition and again exerts its purifying action.

The filter construction is variable and is dependent on the composition of the water. In the accompanying sketch showing a sectional and a plan view, an iron or a wooden cylindrical vessel (*a*) with a conical shaped bottom is charged with permutite. On the cone is a perforated plate (*b*) used for a bottom on which is a layer of coarse gravel, then a layer of fine gravel upon which lies the permutite. This is covered with a loose, uniform layer of fine excelsior which is held

down by a divided perforated cover over which canvas is
564 stretched. Directly above is the outflow pipe (*d*) for the purified water. The raw water enters thru a valve in the pipe line (*h*) which is connected to the bottom of the permutit filter vessel, into a pipe (*c*) which is perforated at its top so that the water passes in uniform distribution through the sieve into the permutit layer; said valve is operated by a float (*e*) in the container for purified water.

The depth of the permutite layer is dependent on the rate of flow of the water and its hardness and is determined by experience. The area of the permutit layer is dependent on the required amount of purified water. To regenerate the permutite a 15 to 20% solution of salt purified by wood charcoal and prepared with warm water is pumped to a tank surmounting the filter. When all the water has been drained from the filter the salt solution is run thru the pipe (*g*), valve (*f*) and the slotted distributing tubes (*k*) onto the Permutite. This is allowed to react with it for about six hours with intermittent draining thru valve (*i*) and subsequent return thru the filter. At the end the salt solution is drawn off and the filter washed out with water till it no longer reacts of lime and salt. The regeneration is either carried out in the night while inoperative, or two filters are operated alternately. The treated water may be reduced to 0° hardness or can be made to retain several degrees of hardness by regulating the flow thru the filter. No secondary reaction occurs in this case in the boiler as is the case with the lime-soda method. Likewise the disagreeable nuisance of the latter caused by the lime-dust and the sludge resulting from the use of soda and the like is completely eliminated. The salt should be fairly well purified.

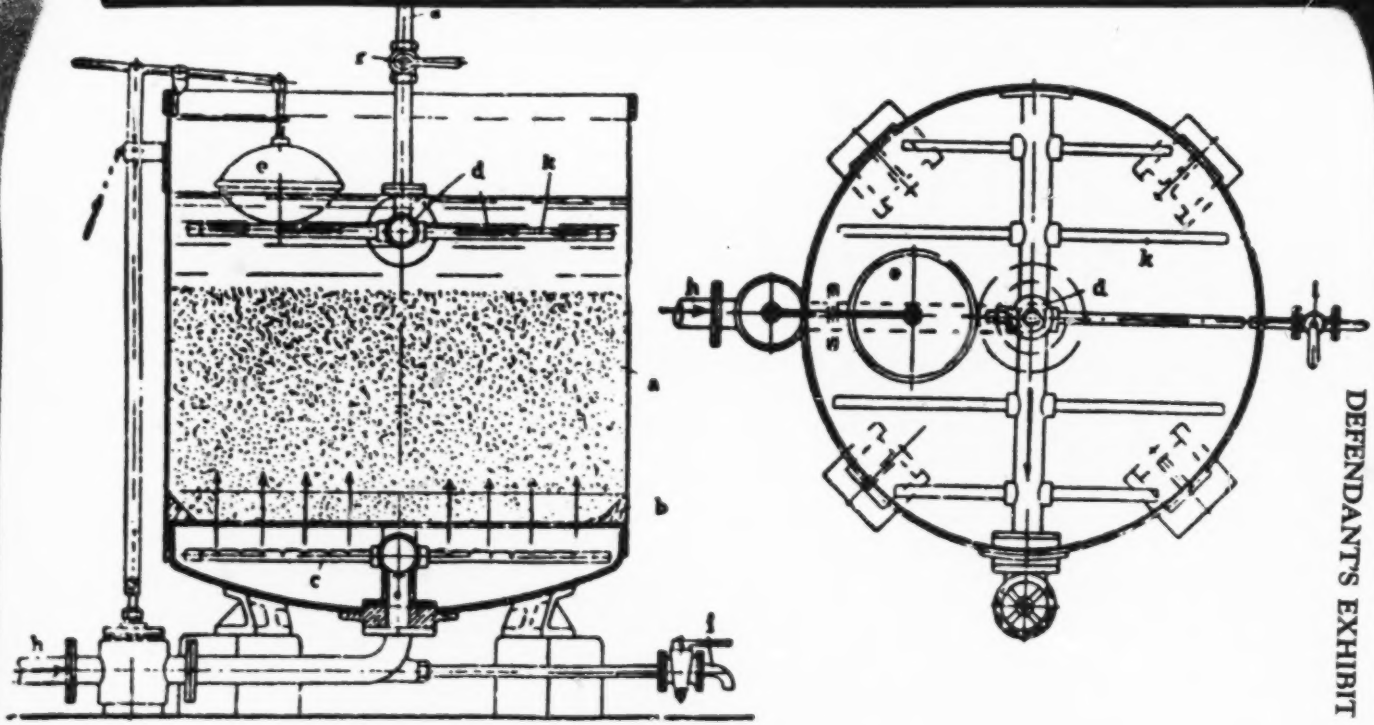
In a Berlin factory there is such a plant for softening daily (10) hours 35 to 40 cubic meters of boiler feed water of 10° hardness (German). Two filters are used which are 2.4 meters high and 1.2 meters diameter, one of which is always idle. Each holds about 700 kilograms of permutite in a layer 70 cm. thick. The flow is about 65 to 70 liters per minute. During the first four or five days the filter gives a water of zero degrees hardness, after which the hardness gradually increases and on the seventh day reaches about 4.5° or
565 °. The filter is then shut off and regenerated with a salt solution of about 150 to 180 kg. salt in 900 to 1000 kg. water. A boiler fed with permutite water for three months showed no trace of boiler scale according to a report of the operator and was considered perfect in every respect.

The following are mentioned as references in the literature to permutite and to zeolites in general:

R Gans "Constitution of Zeolites"
Jahrbuch der Kongl Preussiechen Geologischen Landesanstalt under Bergakademie, Berlin 1906, page 63 to 94.

" " Purification of Drinking Water from Manganese by Aluminium Silicate Chemiker Zeitung 1907 No. 28.

" " Improvement of Drinking and Industrial Waters for Household and Factory by Aluminium Silicate or Synthetic Zeolites.
Mitteilungen aus der Konigl—Prufungsanstalt fur Wasserversergung und Abwadderbeseitigung 1907, Heft. 8.



Permutit-Filter in Schnitt und Aufsicht.

DEFENDANT'S EXHIBIT 28

Permutit Corp. v. Page and Jones
Enlargement of print from Trademark Illustrations
Book Page Allowed July 2, 1907

567 DEFENDANT'S EXHIBIT NO. 27.

Affidavit of EDWARD T. KELLY, in Support of Defendant's Application for Re-Hearing.

UNITED STATES DISTRICT COURT,

Southern District of New York,

The Permutit Company,
Plaintiff,
against
Paige & Jones Chemical Company, Inc.,
Defendant.
} In Equity 27/5.

State of New York, County of New York. } ss.:

EDWARD T. KELLY, being duly sworn, says that the photoprint marked "Exhibit A" is a photostat copy of pages 721 and 722 of a publication entitled "The Practical Engineer" published June 4, 1909, the original of said publication being in the New York Public Library, the photostat copy Exhibit A having been made from said original copy.

EDWARD T. KELLY.

Sworn to before me this 11th day of October, 1927.

FRANZ BORCHMAN,
Notary Public,
Nassau County.
Certificate filed in New York Co.
No. 1448,
Reg. No. 8073A;
Commission expires March 30, 1928.

568 Article Contained in Exhibit A to Affidavit of Edward T. Kelly.

A New Process for the Softening of Water.

A water-softening process recently invented by Dr. Robert Gans of Pankow, near Berlin, is based on the property of artificial zeoliths (permutites, basic aluminate-silicates), to exchange their basic compounds against other bases. The new basic aluminate-silicate compounds produced by this exchange are susceptible of being reconverted again to the original compound, thus serving for a renewed exchange, and so on. In fact, this alternate exchange and regeneration can be

repeated over again as frequently as desired, without any prejudice to the reacting possibilities of the permutites.

The most suitable compound used for the softening of water is sodium permutite, which exchanges its sodium in equivalent amounts against the calcium or magnesium contained in the water, while converting itself into calcium or magnesium permutite and yielding up to the water the soluble compounds (sodium bicarbonate, sodium sulphate) produced by the reaction.

As soon as this exchange has been completed or has reached an admissible limit (which is recognised by determining the degree of hardness by means of a standardised soap-solution) the permutite is regenerated by a hot solution of common salt allowed to flow through the permutite layer at a moderate speed. Common salt denatured by charcoal (in quantities 3—4 times the amount of bound lime) is used for regenerating the substances used in the process.

569 The filtering speed should be adapted to the hardness of the water and the output desired.

The apparatus used in connection with this process is an iron or wooden filter of cylindrical shape, terminating in a cone at the bottom. The height of the permutite layer should bear an empirical ratio to the hardness of the water as well as the rate of filtration. A high permutite layer generally assures a better exchange than the same amount of permutite when arranged in a broad stratum. The conical part of the filter is interrupted in its centre by a horizontal perforated sieve, carrying a layer of coarse gravel, and on the top of this a layer of fine gravel, serving as support to the permutite. The permutite layer, with a view to retaining the fine permutite particles, is covered on the top with a loose though dense stratum of finely-spun wood-wool, kept back immediately below the discharge tube by a perforated cover coated with linen.

The filter, when hermetically closed, can be as well inserted into a water distribution system, thus driving the water after treatment up to a higher reservoir.

As the regeneration process only takes up six hours, an installation comprising a single filter will be sufficient in many cases; should this not be the case, it would be advisable to place at its side another filter to be operated during the time the first filter is regenerated.

A reservoir into which is pumped the regenerating solution of common salt (15 per cent to 20 per cent), prepared in

a pot or vat and filtered through bags, is arranged on the top of the filtering plant.

570 The permutite is not used up to any material degree.

The main advantages of this process are the simplicity of apparatus and ease of manipulation, a stoker being able to superintend its operation beside his ordinary work. By controlling the speed of filtering, the water to be softened is raised either to 0 deg. or to any admissible limit of hardness, as desired. There is no subsequent reaction, as in the case of the lime-soda process, nor are the men inconvenienced in any way (by lime dust, etc.). There is no necessity of carrying away the mud, nor is there any formation of boiler scale.

The manufacture and use of permutite have been patented by Messrs. J. D. Riedel Ltd., of Berlin.

The following instance will give an idea of the working of this process:—

One Berlin factory comprises a plant designed to soften, during a 10-hours' service per day, 35—40 cubic meters of boiler-feed water of 10 deg. of hardness (German scale). This is done by two filters of each 2:4 meters height and 1:2 meter diameter. Each of these filters contains about 700 kgs. of sodium permutite, occupying a height of 70 cms. The rate of filtration is 65—70 litres per minute. There is only one filter in operation at a time.

During the first four to five days this filter supplies a water of 0 deg. of hardness, after which the hardness gradually increases, until the seventh day, up to 4, 5, and 6 deg. The filter, having then been arrested, is regenerated by a solution of 150 kgs. to 180 kgs. common salt, denaturated with coal, in 900 kgs. to 1,000 kgs. water.

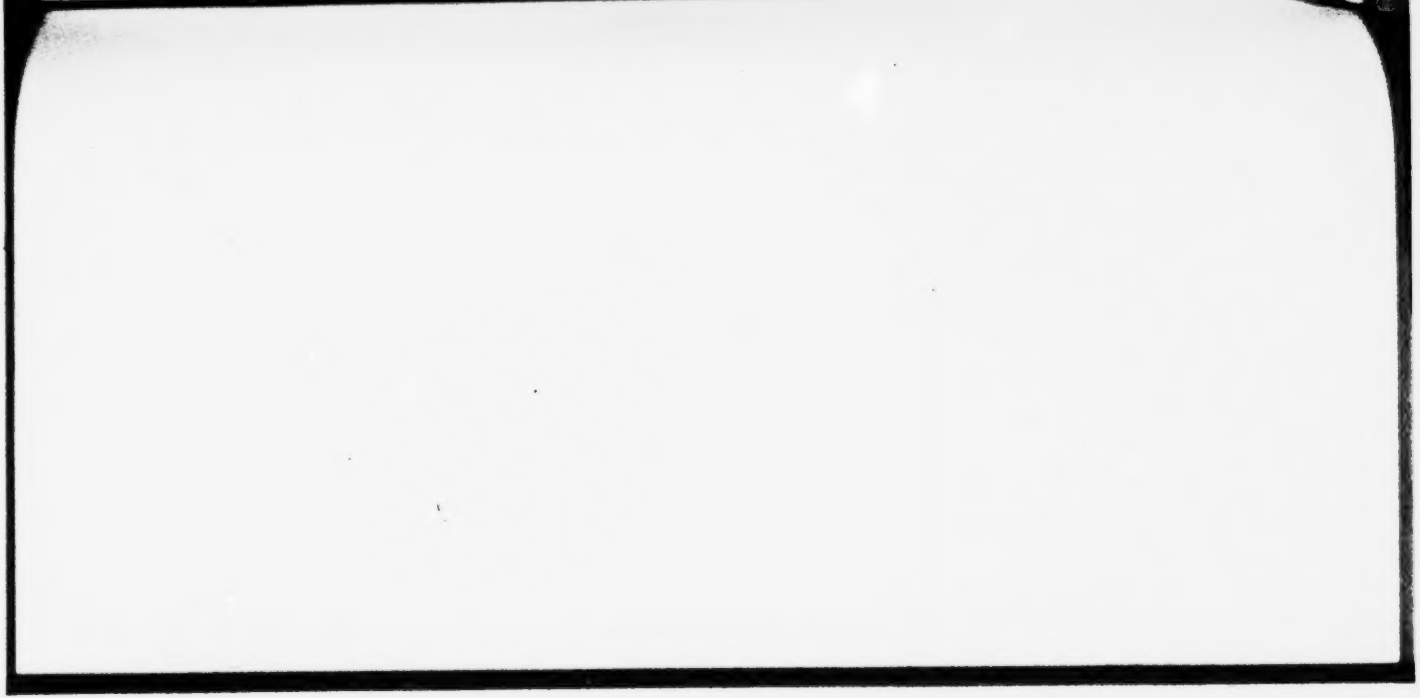
571 In order to regenerate the filter, its water is discharged down to the surface of the permutite layer, after which a warm solution of common salt (of about 50 deg. C.) is filled in from the adjoining reservoir on the surface of the filter and allowed to traverse it intermittently. After being finally rinsed with water until any lime or salt reaction disappears, the filter will be ready for use.

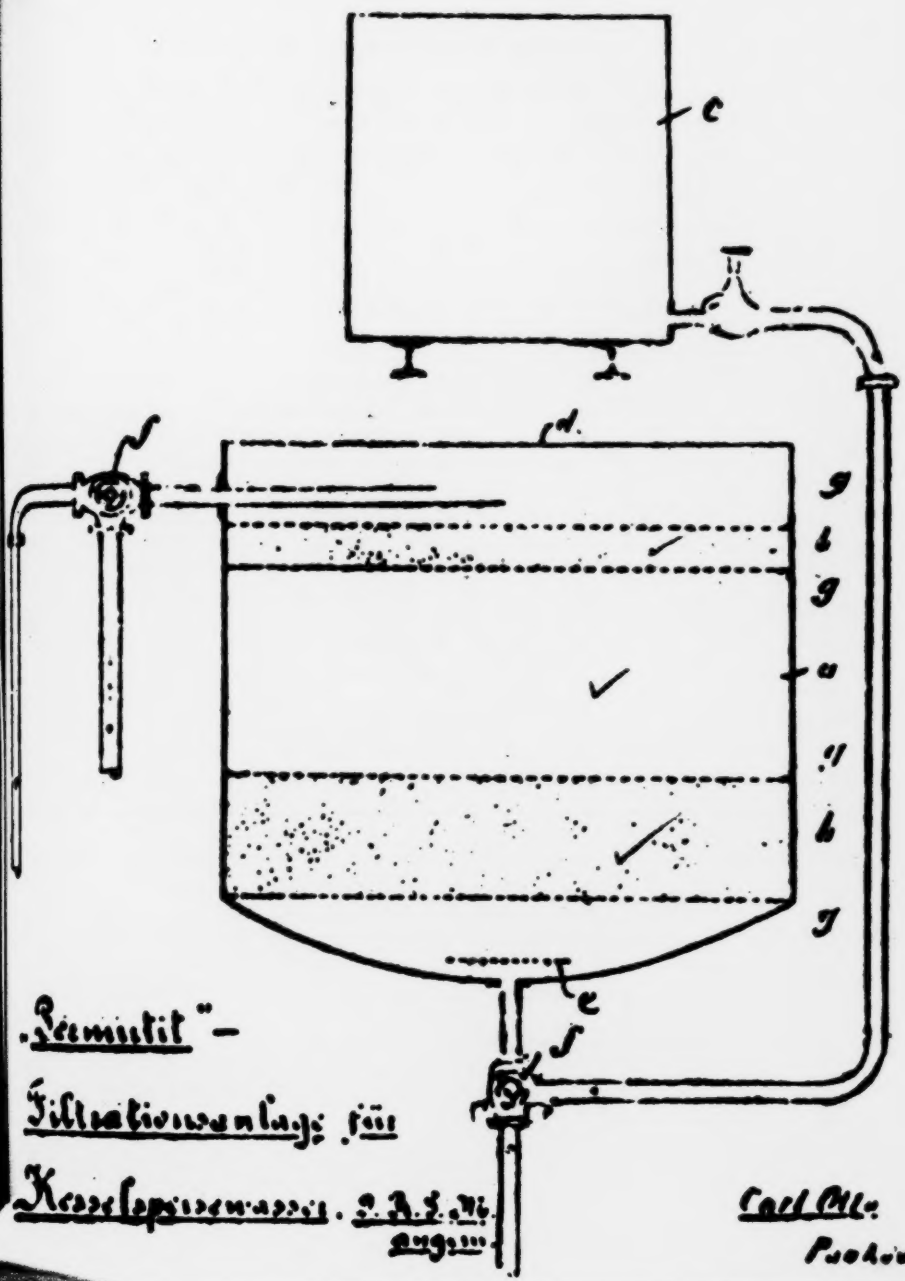
A boiler fed during three months with permutite-treated water did not show any trace of scale, and was found satisfactory in every respect.

DEFENDANT'S EXHIBIT 32.

584-587 (Printed matter from Feldhoff article of September 7, 1907, omitted per stipulation filed June 10, 1930. See index.)

(The following drawing appears in this article:)





„Permutit" –

Filtrationsanlage für

Kesselspeisewasser . D.R.P. No.

Carl Ma

Prosk

588 DEFENDANT'S EXHIBIT NO. 33.

Feldhoff Article Translation.

"Under the name of zeolites are understood hydrosilicates, that contrary to other silicates are readily soluble in acid and almost always contain bases, such as Potassium, Sodium, Calcium, Alumina, also Magnesia. These bodies possess the valuable property of being able to exchange a part of their bases with other bases. This property gives them an important part in nature. For instance, if we pour a solution of alkali chlorides of known content upon a field soil containing zeolite —and all good field soils contain zeolite—we find that in a greater or lesser period of time that a portion of the alkali chloride has vanished and an equivalent part of the alkali earths has gone into solution. This exchange takes place until a state of equilibrium is established. If the salt of the exchanged alkaline earth is soluble as in the case quoted above this result is always rapidly achieved. It is a different case though when the salt of the exchanged alkaline earth is soluble, as for instance when a solution of sodium sulphate reacts upon a calcium zeolite. Here a sodium zeolite and calcium sulphate (gypsum) are formed, the latter of which is as is well known, only very slightly soluble in water and is
589 precipitated. The state of equilibrium is therefore constantly disturbed and the exchange takes place until all the calcium zeolite is transformed into sodium zeolite. The zeolites, therefore, serve to cease hold of the salt added to the soil and enable their absorption by plant life. Upon them depends the use of fertilizer. With a content in zeolites all soluble fertilizer salts added to the soil would soon be washed away by rain water. This phenomenon has been recognized for a long time. Liebig, Th. Way, Mulder, Rautenberg, Ruempler and others have made investigations with zeolites. Lately, Dr. Gans, the chief of the labratory, Institute for the Study of Soils of the Royal Prussian Geological Survey in Berlin, has done further work upon this subject. The explanations which I will give later, in so far as they are of scientific character, are based upon the statements of this investigator.

"To clear up the constitution of the zeolites, and particularly the combination of the alkalines and alkaline earths Gans examined the following natural zeolites:

1. Desmin from Iceland
2. Chabasit from Aussig and Rubendorf in Bohemia
3. Stilbit from Iseland
4. Natrolith from Linda in Silesia
5. Analoim from the Seisser Alp in Tyrol
6. Apophyllit from St. Andreasberg in Tyrol

"Of each of these minerals five grams of the same granular size were digested in Knopps Ammonia Chloride Solution. This solution contains 129 milligrams Nitrogen in each 100 cubic centimeters. After two days' digestion the minerals had exchanged nitrogen in the ammonia chloride solution for lime, as follows:

1. Desmin	0.0420	g	N	exchanged	for	0.0580	g Lime
2. Stilbit	0.0473	"	"	"	"	0.0720	" "
3. Chabasit	0.0690	"	"	"	"	0.1382	" "
4. Natrolith	0.0290	"	"	"	"	0.00146	" "
5. Analcim	0.0036	"	"	"	"	0.0144	" "
6. Apophyllit	0.0000	"	"	"	"	0.0214	" "

"The lime found in the last two samples, Analcim and Apophyllit, is not to be considered as exchange lime, as very little or no nitrogen had been exchanged. We see here in these different minerals a great variation in the exchange base faculty. This faculty which does not depend upon the percentage of composition of the ingredients of the minerals, lead Gans to believe that the zeolites had a varying constitution, which influences their chemical activities. In fact, he succeeded in proving that two series or varieties of zeolites exist. It would be going too far for me today to describe to you the many analyses and experiments that Gans made and which brought him to his conclusions. I call your attention to the interesting publications Gans has made in the Yearbooks of the Royal Prussian Geological Survey for 1905 and 1906. Today we are only interested in the end and results, particularly because they glaringly exhibit the difference between the zeolites introduced into technology by Prof. Rumpler and those brought into the trade by the firm of J. D. Riedel under the name of "Permutite" and which are prepared by the method of Gans. Gans has divided the zeolites containing alumina into two classes:

1. Zeolites in which the major part of alkalies and alkaline earths are bound to the silica, and in a short period of time exchange these bases, but in a very small measure. These he has called for shortness sake "Alumina Double Silicates."

The alumina, the basic alkalies and the alkaline earths display equally and each for themselves one part of the hydrogen of the hydroxyle group in the silica hydrate.

2. Zeolites in which the major part of the alkalies and the alkaline earths are bound to the alumina, and in a short period of time almost completely exchange their bases. These he has called "Alumina Silicates" because the name best expresses their constitution. They contain most of their bases bound, through the intermediary of the alumina hydrate, to the silica. One or two hydrogen atoms of the hydroxyle groups in the silicate hydrate are substituted by the groups Al O Na. O H—or more improbably Al (O Na). Analcim, with the formula Na 2 Al2 Si 4 O12 plus 2H2O would be 691 an alumina double silicate of the first class. This formula might be graphically expressed as follows:

```
Si O Na                          Si O Na
                                    O H
O O O              or            O O
                                    O
Si-O Al OH2                      Si O Al (OH)2
```

"Sodium chabasit with the formula Na2 Al2 Si4 O12 plus 6 H2O belongs to the second class and its formula graphically expressed would be:

```
          OH
Si        OH
                OH
          O Al O Na
O
          OH
Si        OH
          OH
```

To the first class belong for instance Analcim. Second Natrolith, whose low exchange properties we have observed, and thirdly, the artificial zeolite of Rumpler which we will discuss later. To the second class belong Desmin, Stilbit, Chabasit and the artificial zeolite of Gans.

"To elucidate what is stated above I show you a table of analyses made by Gans. He has measured the absorption powers of zeolites by digesting them for two days with the Knopps ammonia chloride solution described above, and found that of the 129 milligrams of nitrogen present the following amounts were absorbed:

Apophyllit	00 mg
Analcim	3.6
Natrolith	29.1
Rumpler's zeolite	30
Desmin	42
Stilbit	47
Chabasit	69
Gans artificial zeolite	97

"Zeolites are widely distributed in nature, but always only in relatively small amounts. Even the zeolite materials
592 used by Harm, such as Bolus in the sugar industry, and the clay soil used by Rumpler contain only a few percent of the real active material. On the other hand the importance of these bodies, scientifically and technically, was readily observed, and efforts were made to prepare them in a pure state. A whole line of investigators,—I'll only mention Brauns, Mulder, Peters, Rautenberg, Rumpler,—have worked on this problem and also achieved results. Sometimes the high cost of manufacture stood in the way of a real technical use, other times only an alumina double silicate with low exchange properties was exchanged. In the latter class belong, as I have already stated, the artificial zeolites of Rumpler. He precipitated water glass and alumina salt solution with lime solution, or later he mixed cement with infusorial earth or ochre. In both cases as Gans has proven convincingly in his publications cited above, he only was able to obtain alumina double silicates. Gans succeeded first in preparing true alumina silicates. He melted three parts Kaolin, three parts sand and twelve parts of soda together and obtained a flux which extracted with water gave upon analysis the following composition:

SiO2	42.80%
Al2 O3	23.12%
Na2 O	14.5 %
Water	20.17%

These artificial zeolites exceeded by 30% as I have shown you, the exchanged base faculty of the strongest natural zeolite, Chabasit. Later Gans developed whole series of methods of preparation and had himself protected. All these preparations and applied patents are in possession of the firm of J. D. Riedel. The resulting zeolites were introduced into the industry under the name of 'Permutites.'

"The alumina silicates of Gans, that from now on I will

call permutites, are crystal-like bodies of yellowish color. In hot and cold water they are insoluble, also in alkaline fluids. They are, as is readily observable, to the naked eye easily permeable to fluids. In my experiment, made at the sugar
593 refinery at Glogau, and which I will discuss more particularly later, I was able to filter without difficulty juices of 56 Brix. The size of the permutite granules is more or less under control, up to a certain point. A small grain is preferable, as it exposes a large surface to the fluids to be filtered—of course, though, it must not be so fine that permeability is hindered. These permutites have a definite exchange faculty of from 14 to 15%, dependent upon their content in Na2 O. In consequence one kilogram of permutite exchanges its 150 grams Na2 O with an equivalent amount of K2 O, CaO, Mg O, T12 O3 Mn2 O2 etc.

"It goes without saying that in actual practice an excess of permutite is used, depending upon the rapidity with which the filtering takes place.

"I will now perform before you some exchange base experiments with permutite, and will commence with a calcium removal or de-liming of water. In the filter here I have sodium permutite. I pour over it local water that I estimate at about 10 German hardness degrees—analysis I was not able to make. You see, the water is, after filtration entirely free from lime. Through this little filter that contains about one kilogram of permutite I could smoothly de-lime about one cubic meter of water of 10 German hardness degrees and without the smallest technical difficulty. It would be 'carrying owls to Athens' for me to waste many words for this assemblage of recognized skilled engineers upon the value of a rational method of de-liming boiler feed water. Yet I will not pass over unmentioned the not generally known facts published by Max Schroeder in 'Journal for Steam Boilers and Engine Practice' that a layer of boiler scale 1.5 mm thick on the boiler plates will increase the fuel consumption required for generating the same amount of steam 19% over that required with clean boiler plates. A layer of scale 16 mm thick necessitates an increase in fuel consumption of about 38%. This in addition to the strong corrosive action of the scale upon the iron parts. In general one considers a boiler feed water with three degrees German hardness as not harmful; the Prussian Railroad Administration uses, nolens volens, in many places water with six degrees German hardness.

594 "By the use of the permutites it is now made possible to produce water in sufficient quantities that is entirely

free from lime and at inconsiderable cost as I shall show later in the expense sheet calculation.

"Here is a filter that is capable of completely de-liming about forty cubic meters of water of ten German degrees hardness in ten hours.

"The water to be purified is lead in from below, passes through a layer of gravel, provided for the protection of the permutites from mechanical impurities, forces itself through the permutite layer and leaves the filter fully de-limed by the outlet funnel *d*. When the filter is exhausted one passes a hot fifteen percent solution of sodium chloride through it and the proportion of about one-half kilogram salt to every cubic meter of the water filtered, and moreover via the same path as the water, by turning the two-way valve. In circulating the salt solution—the step of regeneration,—a lower circulation speed is chosen about one-fifth to one-sixth of the original rate of flow. Thereafter follows washing out with a strong stream of water until all the salt has been removed, when the filter is again ready for use. Here I have a 'regeneration.' In the filter is exhausted permutite, over which I pass a fifteen percent sodium chloride solution. We observe how rapidly the lime is exchanged.

"The firm J. D. Riedel erected such a filter in one of its plants; as a result of the experiences therein gained, the following data as to its profitableness have been obtained.

"In the said plant are installed 2 Carnwall boilers with 112 square meters of heating surfaces and an over-pressure of 8 atmospheres. The daily consumption of raw water, which has in Berlin an approximate hardness of 10 German degrees, is 40 cubic meters. Heretofore the annual cost of cleaning the boilers was about 1200 Mark. We now employ a permutite filter, filtering 40 cubic meters daily or 240 cubic meters in six days. On Saturdays, just before closing, we regenerate and with a solution of 120 kgs. of common salt in about 800 meters of water. On Sunday or Monday the filter is again washed out and is again ready for re-use.

595 The filter installation cost is approximately 1200 to 1500 Mark, which, written off at 5% corresponds to 60 to 65 Mark annually. The permutite in the filter, 600 to 800 Mark, which, written off at 10%, is equivalent to 60 to 80 Mark. The annual consumption of common salt is 600 Kgs. This amount is delivered, free from stone and denatured with charcoal dust, at a cost of 1.31 Mk. per 100 kg. or 1.50 Mk. including freight charges, so that the 6000 kg. costs about 90 Mk.

I estimate the cost of water for washing at 10 Mk. and the total expenses at 275 Mk. per year; so that the adoption of the permutite installation and avoidance of the expense of cleaning the boilers from scale means an annual net gain of about 900 Marks. Of still greater importance than the avoidance of the need of boiler cleaning, which may cost less than estimated above in localities where labor is cheap is the greatly diminished fuel consumption of boilers that are kept free from scale. A thickness of boiler scale such as is unavoidable even with the best of attention on the part of the boiler tenders, will always necessitate an additional coal consumption of from 4 to 6%, which in the case considered, corresponds to 1200 to 1800 Mk. To the above advantages we must add the fact that interruptions of the operation of the boiler plant due to the necessity of periodically removing the scale from the boilers and the resulting injury to the material of the latter, are absolutely avoided."

He describes the alumina silicates of Gans and exhibits samples to the audience and calls attention to their physical appearance especially and the fact that they are readily permeable to fluids. He states that his experiments at the sugar factory at Glogau disclosed to him that the size of grain is material in the filtering plant and that permutite exposes a large surface to the fluid to be filtered, although, of course, it should not be so fine that permeability is hindered.

Mr. Feldhoff then proceeds to exhibit to his audience some exchange base experiments with permutite, notably the removal of calcium or de-liming of water. His apparatus used in the demonstration is simplicity itself, consisting of a simple filter charged with sodium permutite. Over this he pours water taken from the local hydrant and demonstrates to 596 the audience the fact that the water, after filtration through the permutite bed, is entirely free from lime. He claims that even with this little filter, containing only one kilogramme of permutite, he could readily soften about one cubic meter of water of ten degrees German hardness without any difficulty whatever; to prove the actual de-liming or softening of water he applies the well known oxalate test.

Having made his preliminary experiment, the lecturer now calls attention to an apparatus built on a larger scale and which is in operation in one of the plants of the Riedel Company where this base exchange process of softening water is applied on a commercial scale. To this end he exhibits a drawing of the plant, a copy of which will be found on page

1309 of this publication. He states that this apparatus is capable of completely de-liming or softening forty cubic meters of water of ten German degrees of hardness, in ten hours.

Proceeding with his lecture he explains the vital parts of this apparatus and illustrates them to his audience from the drawing.

Feldhoff describes a layer of gravel B at the bottom. This gravel layer serves, as he says "to protect the bed of permutite from mechanical impurities." He says that the water to be purified is led in from below, passing through the layer of gravel, then through the layer of permutite and leaves the filter fully de-limed at outlet funnel D at the top.

The drawing he exhibits so plainly speaks for itself that he does not stop to point out that the permutite bed is identified by the letter A or that the top layer B is also gravel. In fact, a wordy description of so simple an apparatus on the part of the lecturer speaking to a meeting of technical engineers would be almost an insult to their intelligence.

Mr. Feldhoff does not go into any but a most superficial description of the apparatus depicted on the chart, but he does go at great length into what occurs inside of it, especially the feature involving the regeneration of the exhausted permutite bed. He states that when the filter is exhausted a suitable solution of common salt should be passed through it and gives the proper concentration as being fifteen per cent. Also, that it should be introduced hot and follow the same path through the apparatus as the water to be softened had taken, that is, from the botom up.

597 He also describes the use of a two-way cock enabling this shift in the introduction of the solutions, although he does not specifically mention the identifying letter of this valve.

The rest of the apparatus, including the salt solution tank C, he does not take time to mention in his lecture to this intelligent audience. Neither does he concern himself as to the means for making the salt solution which he said should be done, naturally assuming that a man skilled in the art would readily devise means for making the proper solution of salt in the tank marked C.

Contining his description of the method used in regenerating the exhausted permutites, he gives a definite rate of flow of the salt solution to pass through the filtered bed, that is, about one-fifth to one-sixth of the speed of the water purification process. Having regenerated the zeolite, the whole apparatus is flushed out, as he states:

"The apparatus is washed out with a strong stream of water until freed from sodium chloride, and then the filter is ready for further use."

From what has been said it is obvious what Mr. Feldhoff is attempting to convey to his listener is not any particular detail of construction of an apparatus, but rather the use of permutite as a water softener, and the fact that upon exhaustion it can be restored to its previous water softening capabilities by a simple process of putting it into contact with a suitable salt solution, washing it out and resuming operations as a water softening plant without the removal of any part of the filter bed from the apparatus.

The point emphasized by Mr. Feldhoff to his audience is not the efficiency of the apparatus employed, but the efficiency of his zeolite for softening water. Having described this exceedingly simple apparatus to his audience while referring to the drawing, he proceeds to prove that the water has actually been softened and continues his experiments with the filter he first exhibited. He now states, following up his previous experiment, that the filter contains exhausted permutites and he passes over them the fifteen per cent. solution of sodium chloride referred to; then taking a sample of the filtrate and testing it, calling the attention of his audience to the success of the demonstration by stating:

"We observe how rapidly lime is exchanged."

598 Mr. Feldhoff, an employe of the Riedel firm, then proceeds to describe to his audience the actual commercial operation of one of these filters, the results obtained technically, and the savings effected by its use. He says that it will and does completely soften forty cubic meters of water of ten German degrees of hardness per diem, or rather in ten hours. Further, that it operates five days in succession and has only to be regenerated once a week.

Proceeding with his lecture, Mr. Feldhoff next exhibits a demanaganization of water by means of permutites. He does this before the eyes of the audience and with the same simple filter apparatus he used in his previous demonstration. He does go quite deeply into the advantage of removing manganese from potable waters by the means of permutites and gives chemical reasons why iron water, for instance, should be filtered through the permutites without coming in contact with the oxygen of the air, which would interfere with the reaction. He states that this property of permutite can readily be taken advantage of in the small household filter where only a few

cubic meters of water are to be treated per diem, but that on a larger scale, such as a city or a village water works, it is better first to remove the iron by oxidation and then perform the demanganization.

Having concluded his lecture and demonstrations, the attending scientific technical experts freely discussed the facts laid before them and frankly stated that Mr. Feldhoff had not exhibited anything startlingly new and that purification of beet sugar juices by means of zeolites was old. The work of Harm and Rumpler was quoted by them. No criticism whatever was made by these gentlemen of the apparatus employed by Rumpler, Harm or Feldhoff, although some of them expressed grave doubts as to whether this sugar purification process could be applied technically on a large scale on account of its interfering with the sugar industrial processes. So far as the apparatus is concerned, everyone took it for granted than an ordinary filter such as exhibited was entirely satisfactory.

One of the experts, Dr. Eckel, states that at the Luben factory a large apparatus was put together, made up of twenty-seven old bone-coal filters, filled with zeolites and filtration worked admirably. He states, however, that difficulty
599 was experienced in the regeneration, due to inherent defects in the zeolite used and the peculiar demands of the sugar manufacturing process.

Although Dr. Feldhoff did not deem it necessary to explain to the assembly of scientific men present at his lecture a drawing so obviously speaking for itself, it is perhaps appropriate at this time to describe the constructional features of the permutite filter illustrated on page 1309 of the Centralblatt. The filter casing is substantially a plain iron cylinder, with convex bottom; disposed at various levels in the casing are a series of four perforated supporting plates G. The lowermost plate G supporting a layer of gravel B, the next plate G supporting a layer of permitit (zeolite), the next plate G supporting a superposed layer of gravel B, and the uppermost plate G resting upon the top of the superposed bed of gravel. The member E is obviously a strainer. The raw water enters the casing through the lower vertical pipe, not lettered, controlled by the two-way valve F. This water passes upwardly through the filter and is softened by contact with the bed of sodium zeolite, leaving the filter in a softened condition by way of the collector cup D; thence through a horizontal pipe associated therewith through the upper valve F and thence to

use or to a soft water tank. The letter C indicates a salt solution tank. For regeneration the lower two-way valve F is turned, thereby shutting off the raw water inlet and permitting the flow of the sale solution from the tank C upward through the strainer plate E and into the casing via the same path as the raw water, the lime leaving the tank through the collector cup and connecting pipe and directed by means of the valve F which has been turned to a sump or to the sewer. As stated by Mr. Feldhoff, the introduction of the salt solution regenerates the bed of zeolites in the casing.

So far as constructional features are concerned, the filter apparatus exhibited by Mr. Feldhoff in this drawing is identical with the apparatus illustrated and claimed in the Gans patent in suit here, No. 1,195,923.

Feldhoff presented to the assembly of scientists a water softening apparatus comprising a casing, a filter bed consisting of a layer of sand or quartz and a layer of zeolites or hydrate alumina silicates disposed on the layer of sand or quartz, means for admitting the passage of the water through the casing, the vertical pipe entering at the bottom of the 600 casing, means for cutting off the supply of water on the exhaustion of the zeolites (lower valve F), and means for passing through the casing a solution of a salt capable of regenerating the zeolites. The last mentioned means being the tank C, the lower valve F and the intermediate pipe.

It is to be especially noted that Mr. Feldhoff states that the firm of J. D. Reidel & Company, who were the patentees of the Gans patent in suit, erected such a filter as exhibited in this drawing and achieved successful results in the softening of water, a detailed statement of the monetary savings effected being given by Mr. Feldhoff.

Chicago, April 27, 1920.

This lecture of Feldhoff's was a considerable surprise to Dr. Rumpler, who came back in the next year's issue of the Centralblatt in a sarcastic review of this ground covered by Mr. Feldhoff. Dr. Rumpler's reply appeared in the issue of November 16, 1907, of the Centralblatt fur die Zuckerindustrie, at pages 172, 173 and 174.

Dr. Rumpler points out, as I have mentioned several times, that the burden of Gans' and Feldhoff's claims were to the point that "permutite", which was Dr. Gans' particular kind of zeolite, produced better results than the natural zeolites and the zeolites prepared artificially by previous investigators. As Dr. Rumpler states:

"The fact that Feldhoff used permutite instead of the sili-

cate prepared by me at that time from cement does not alter what regards the process at all.

Rumpler does not criticize Feldhoff's apparatus.

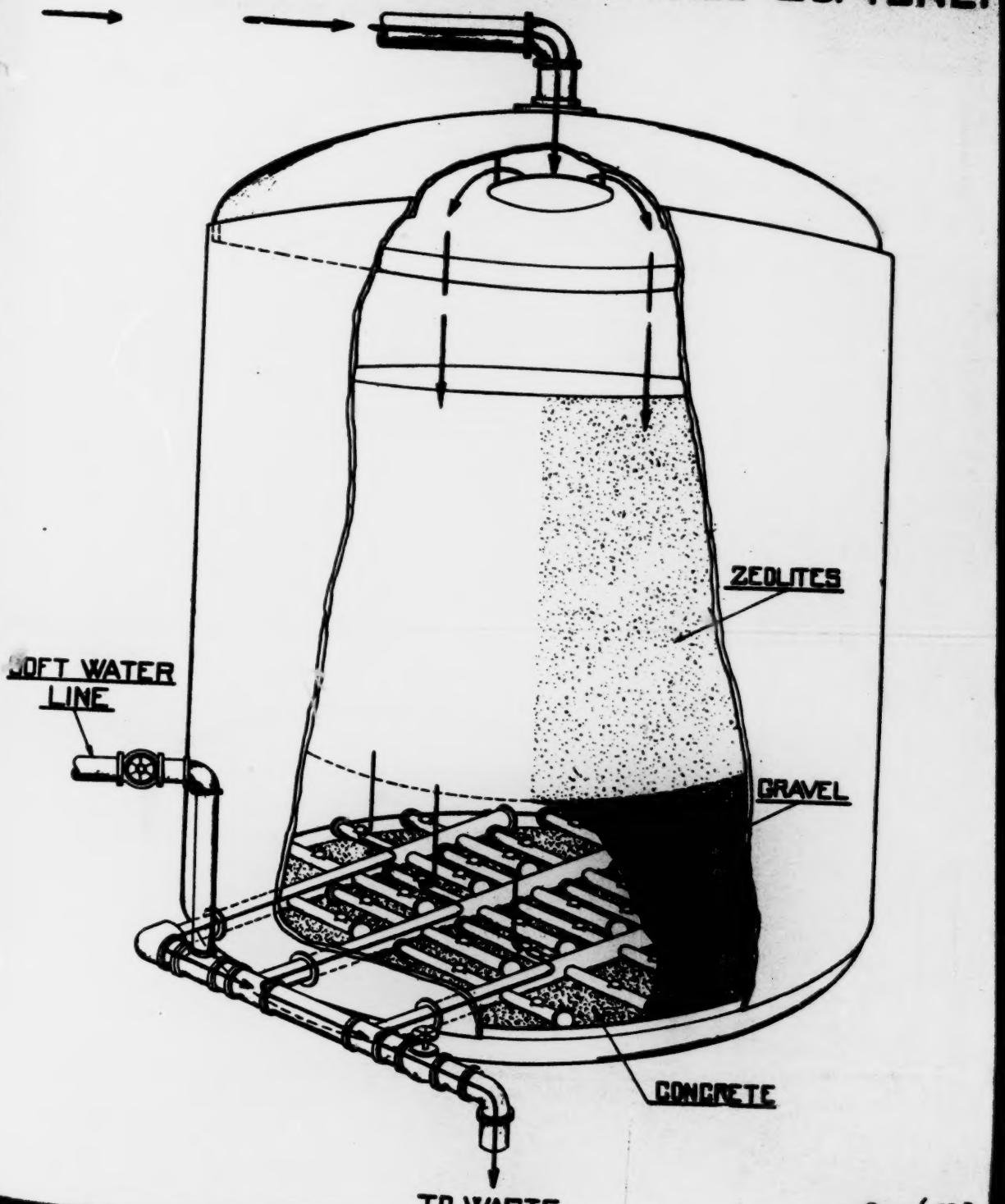
In the article now under consideration Rumpler challenged Feldhoff's statement that the experiments which Feldhoff performed were new, stating that in his, Rumpler's, lecture before the Chemical Society of Breslau he softened water by the use of zeolites. He also states that even the idea of removing manganese from water by means of filtration over zeolites cannot be admitted as new, as the subject had been studied several years prior by a young student at the Breslau Agricultural Institute.

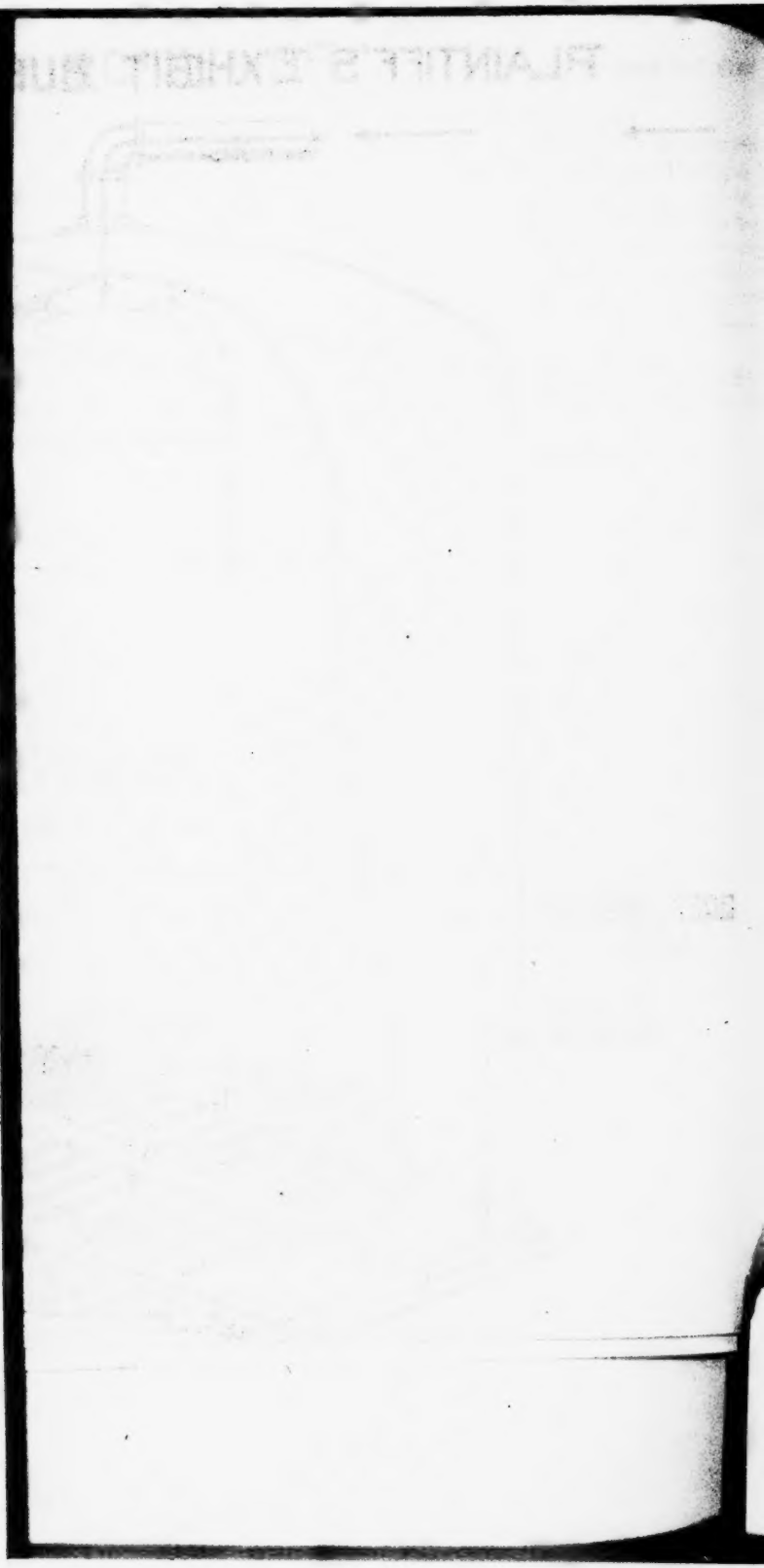
So far as the apparatus employed is concerned, Rumpler says, "The way and means by which zeolites are technically applied is not new".

This attack by Rumpler brought an immediate re-

DEFENDANT'S EXHIBIT 36

PLAINTIFF'S EXHIBIT BUFFALO SOFTENER





Defendants Exhibit #37

SOFTENER IN DETROIT CASE.

Fig. IV.

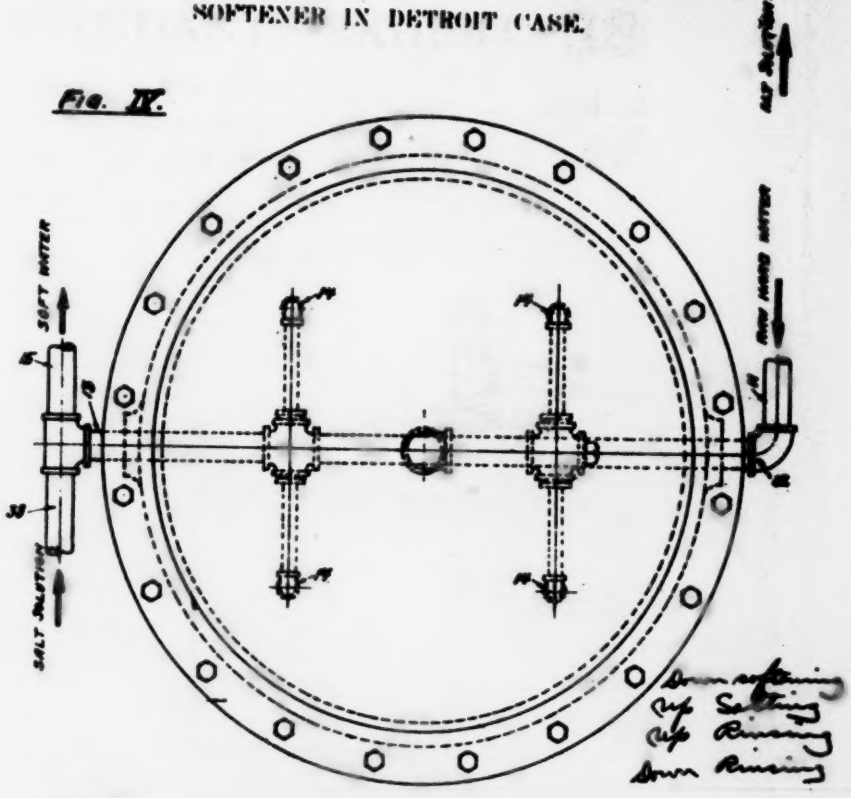
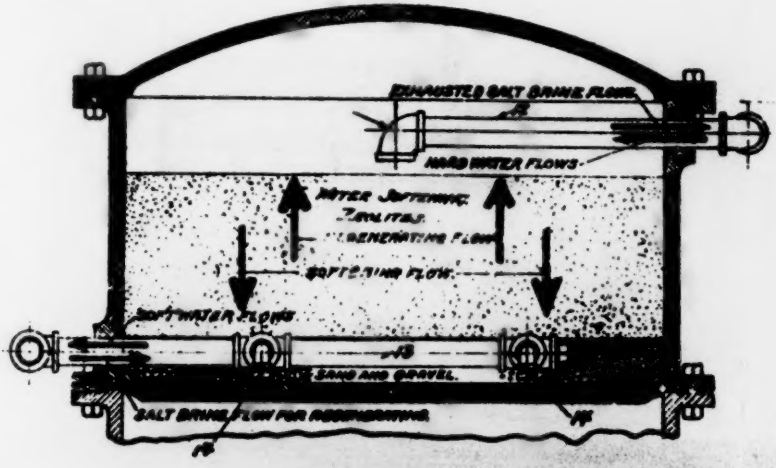
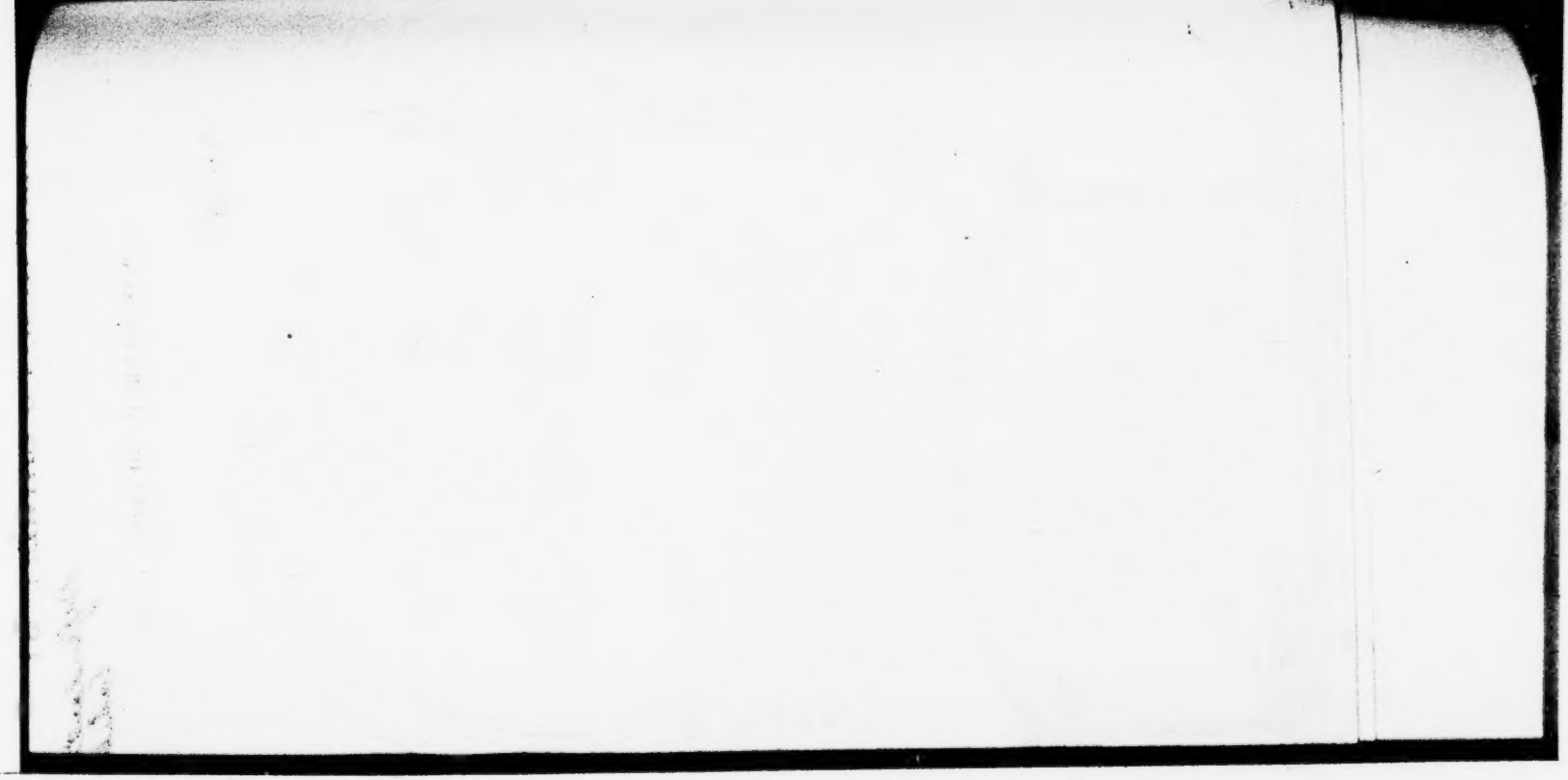


Fig. V.



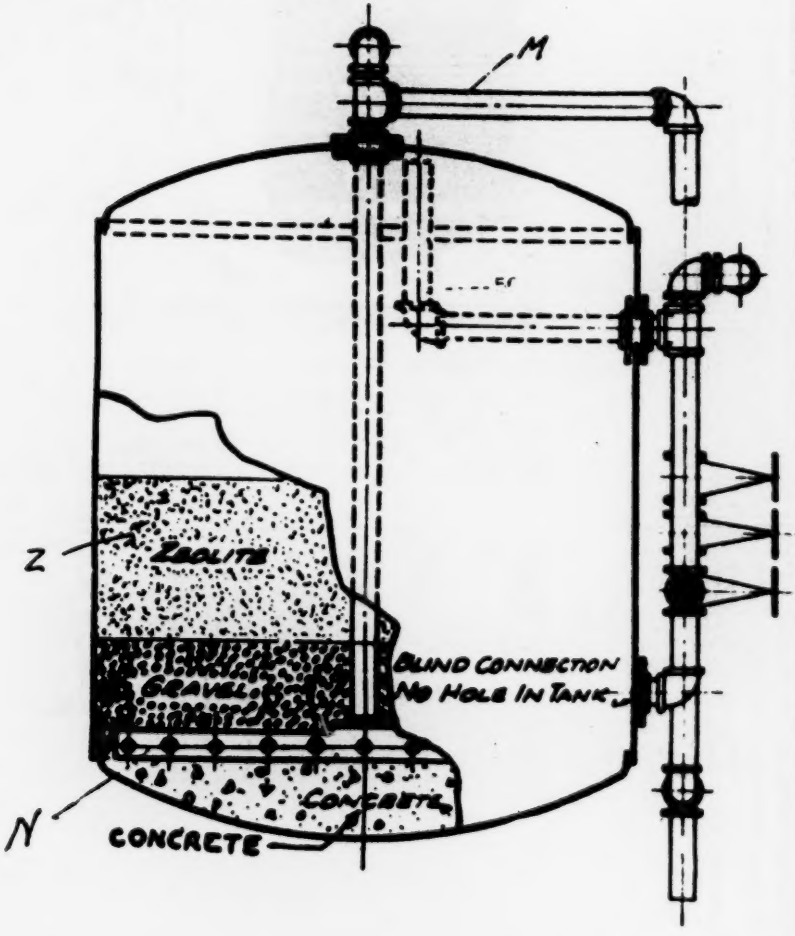
ZEOLITE WATER SOFTENING PLANT.
MASSACHUSETTS LAUNDRY.
DETROIT. MICH.



DEFENDANT'S EXHIBIT 38

Defendants Exhibit #38

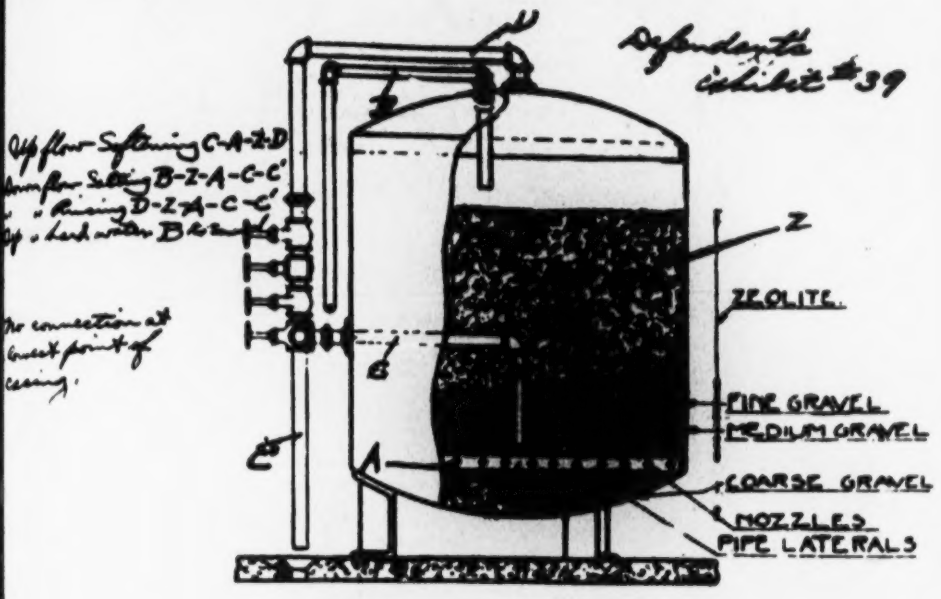
P.J. UPFLOW SOFTENER



UPFLOW SOFTENER

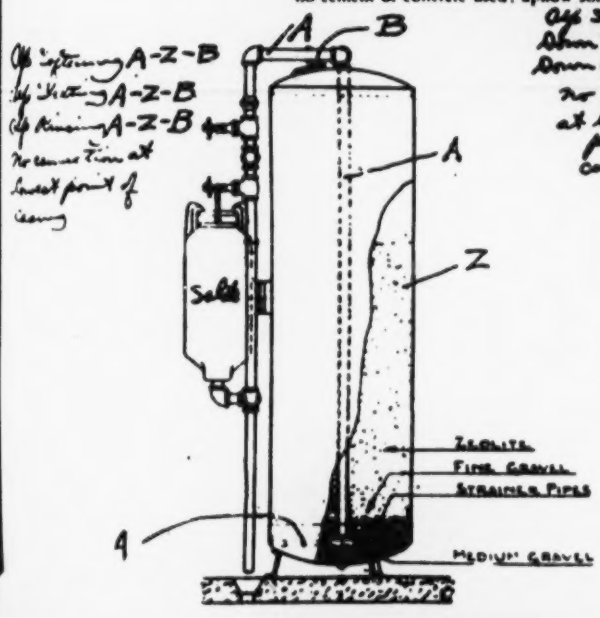
Concrete fill below strainer system

DEFENDANT'S EXHIBIT 39



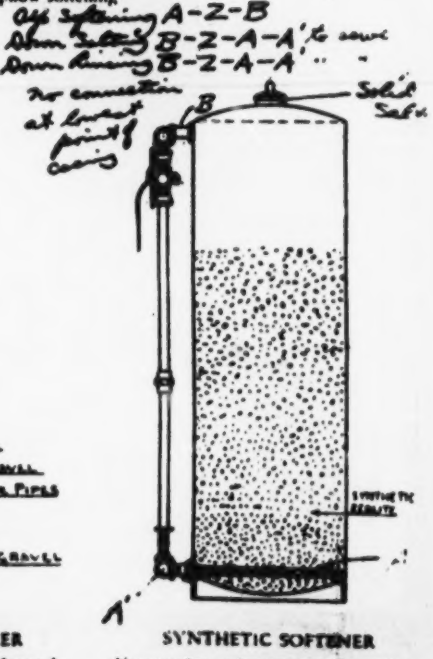
INDUSTRIAL SOFTENER REDESIGNED

The till below the strainer system consists of gravel no cement or concrete used, upflow softening



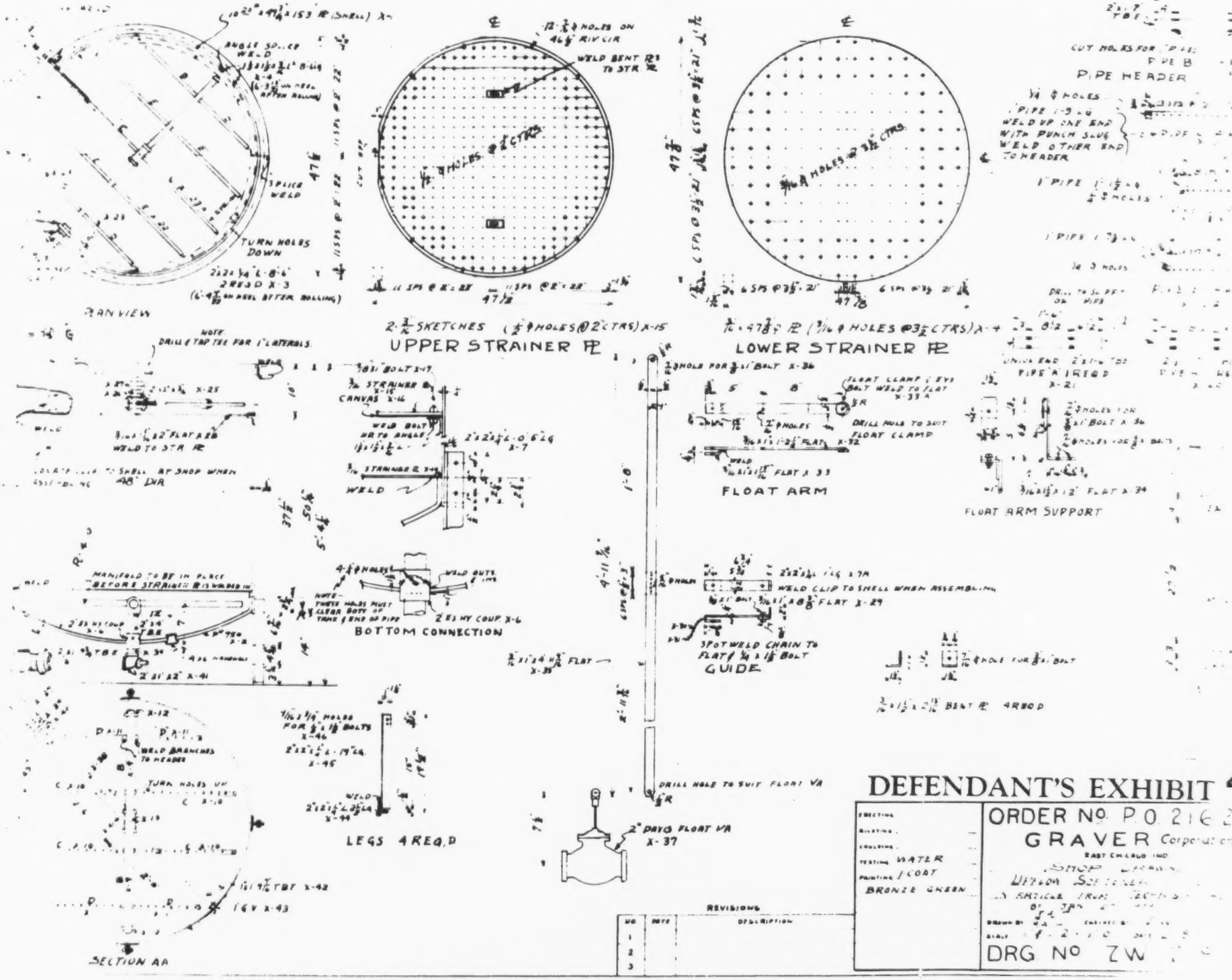
DOMESTIC – GREENSAND SOFTENER

The till below the strainer system consists of gravel, no cement or concrete used, upflow softening



SYNTHETIC SOFTENER

No gravel or other support for zeolites, they rest upon lower head of shell, upflow softening


PLAN VIEW
2-3/4 SKETCHES (1/2 ø HOLES @ 2" CTRS) X-15
UPPER STRAINER PL
7/16 x 47 7/8 ø PL (3/16 ø HOLES @ 3 1/2 CTRS) X-4
LOWER STRAINER PL
PIPE HEADER
FLOAT ARM
FLOAT ARM SUPPORT
BOTTOM CONNECTION
GUIDE
LEGS 4 REQ'D
SECTION AA
DEFENDANT'S EXHIBIT
ORDER NO. P.O. 216
GRAVER
DRG NO ZW
REVISIONS
THIS DRAWING IS THE PROPERTY OF GRAVER Corporation AND MUST BE RETURNED

616 DEFTS'. EX. 41.

* * (Caption) * *

STIPULATION.

It is hereby stipulated and agreed by and between counsel for the respective parties hereto that the following is a true and correct statement regarding certain tests conducted by defendant at the Hawthorne Laundry Service, Hawthorne, New Jersey, on the 12th day of September, 1929.

Pursuant to a notice, representatives of the parties hereto, met at the Hawthorne Laundry Service, Hawthorne, New Jersey, in the afternoon of Thursday, September 12th, 1929. The following persons were present on behalf of the defendant:

Messrs. C. L. Byron, B. V. Moses, V. F. Lamela, R. Riley, J. G. Dye, T. B. Clark, W. E. Titus.

On behalf of the plaintiff: Messrs. A. C. Bakewell, F. N. Waterman, E. W. Hammer, H. Kriegsheim, Eugene Staegemann, W. Lindsey, Eric Pick.

Also attended Mr. William S. Pritchard.

617 The device tested by the defendant in the presence of the representatives of the plaintiff comprises an open top apparatus containing zeolites, such apparatus being made in structural features (but not as to piping) in general accordance with the blue print of defendant's drawing No. ZW718 marked for identification as defendant's Exhibit No. 40 so far as examination disclosed to plaintiff's representatives.

Previous to the start of the test raw water was passed upwardly through the zeolite bed in the container until a test of 40 cc of effluent indicated that no lather was formed upon the addition thereto of 5 drops of standard B & B soap solution.

In testing this effluent, it was found that 9 drops of B & B soap solution were required to secure a lather.

The raw water was Hawthorne City, New Jersey water of approximately 6.5 grains (111 p.p.m.) hardness as drawn from the mains. No chemicals were added thereto.

The regenerating brine was contained in an elevated tank connected to the upper manifold of the water softener.

At the start of the test the casing containing the zeolite bed was drained of water through the lower drain valve and then the valve was closed (this draining operation requiring 36 minutes). 242 gallons of salt solution contained in the elevated tank, a sample from which tested 15% salt in the solution (15 degrees Be) were then passed through the upper manifold into the casing and allowed to pass into the zeolite bed. This operation during which the zeolite containing tank was filled to within one inch of the top thereof required 40 minutes. This salt brine was allowed to remain in contact with the zeolite for a period of one hour during which
618 time 2½ gallon portions were drawn from the lower drain cock and dumped into the open top of the casing at intervals of ten minutes, making a total of six portions drawn and returned. Thereupon the casing was again drained through the lower drain cock and then the drain cock was closed. This salt draining operation required 41 minutes.

Raw water was then admitted to the bottom of the casing, and passed upwardly through the bed of zeolites for washing said zeolites, the wash water filling and overflowing the casing. This washing operation was continued for 15 minutes, whereupon a test of the effluent with the standard B & B soap solution showed a good lather with 3 drops of said solution.

A meter installed in the raw water supply line showed a reading of 1383670 gallons at the beginning of the wash period and 1384610 gallons at the time soft water was obtained, indicating a total of 940 gallons were used in this washing operation.

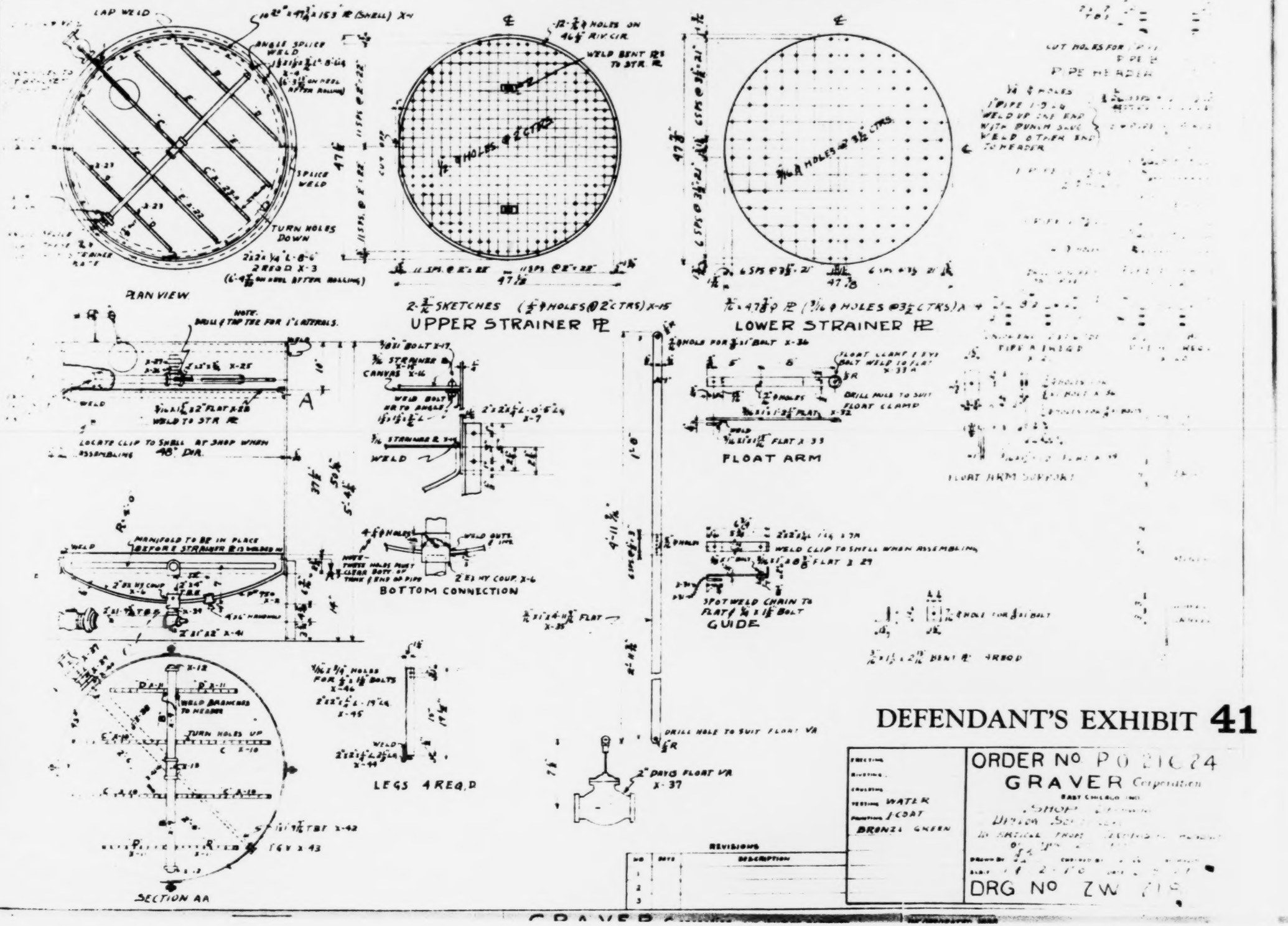
After said regeneration was completed and soft water obtained, the casing was drained and the softener dismantled down to the top of the lower plate for inspection by representatives of both parties.

It is understood and agreed that both parties may introduce evidence with respect to all matters relating to the structure and operation of the tested apparatus.

Counsel for Plaintiff

Counsel for Defendant

September 14, 1929.



DEFENDANT'S EXHIBIT 41

620 DEFENDANTS EXHIBIT #42

* * (Caption) * *

STIPULATION.

It is hereby stipulated and agreed by and between the respective parties hereto that the attached are true and correct copies of Notice, Motion, Affidavit of James Q. Rice and disclaimer which form a part of the Court Record in the suit of *The Permutit Company* v. *Wadham, et al,* reported 294 Fed. 370, 13 Fed. 2nd, 454 and 15 Fed. 2nd, 20, and may be received in evidence in this present case with the same force and effect as if adduced as evidence in this suit.

COOPER, KERR & DUNHAM
Counsel for Plaintiff.
WILKINSON, HUXLEY, BYRON & KNIGHT
Counsel for Defendant.

Chicago, Illinois
September 16, 1929

621 UNITED STATES DISTRICT COURT,
Eastern District of Michigan,
Southern Division.

The Permutit Company
vs.
Frank L. Wadham, Barnet Dalitz, Aaron Jackson and Nathan Dalitz, doing business as Massachusetts Laundry Company. } In Equity.

Sir:

Please take notice that we shall present the within entitled motion to the above entitled Court at its court rooms in the City of Detroit, at o'clock, March , 1920, or as soon thereafter as counsel can be heard.

Yours etc.
(Signed) WHITTEMORE, HULBERT & WHITTEMORE
Solicitors for Plaintiff.

Dated March , 1920.

To—
MANCHESTER AND MCCREDIE,
Solicitors for Defendant.

UNITED STATES DISTRICT COURT,

Eastern District of Michigan,

Southern Division.

The Permutit Company
vs.
Frank L. Wadham, Barnet Dalitz, Aaron Jackson and Nathan Dalitz, doing business as Massachusetts Laundry Company. } In Equity.

And now comes The Permutit Company, plaintiff in the above entitled cause and moves this court that an order be entered permitting the record in this cause to be re-opened; that said order provide that the plaintiff may introduce 622 in evidence a copy of a certain publication (and translation thereof) lately brought to its attention viz. Report of an address by Feldhoff-Pankow under the title "Ueber naturliche und kunstliche Zeclithe—'Permutite nach Dr. Gans'—und deren technische Verwendung," on pages 1307, et seq. of Centralblatt fur die Zuckerindustrie, Vol. 15 for October 1906-September 1907, and also its disclaimer, a true copy of which is annexed hereto; that within ten days after the order hereon is entered plaintiff may take testimony concerning the disclosure of said publication, and that defendants have ten days after the close of said testimony to take testimony in reply to plaintiff's said testimony.

THE PERMUTIT COMPANY,
by
Solicitors and of Counsel.

UNITED STATES DISTRICT COURT,

Eastern District of Michigan,

Southern Division.

The Permutit Company
v.
Frank L. Wadham, Barnet Dalitz, Aaron Jackson and Nathan Dalitz, doing business as Massachusetts Laundry Company. } In Equity.

City, County and State of New York. } ss.

JAMES Q. RICE, being duly sworn, deposes and says:

I am of counsel for the plaintiff in the above entitled cause; I have learned of the existence of a certain publication known as a Report of an address by Feldhoff-Pankow, under the title "Ueber naturliche und kunstliche Zechlithe—'Permutite nach Dr. Gans'—und deren technische die Zukerindustrie, Vol. 15 for October 1916-September 1907, which contains subject matter which, in my opinion, should be before this court in the disposal of this cause, and of which publication I was ignorant until it was called to my attention within the last few days. In view of this publication, the plaintiff, acting under my advice, has mailed to the United States Patent Office a disclaimer of which the annexed is a true and correct copy, such disclaimer limiting the scope of claim 1 of said patent in suit. In my opinion, it is to the interest of all parties that this disclaimer, publication and the testi-
623 mony which it is proposed to introduce respecting the publication be before this court on the trial of this cause.

JAMES Q. RICE

Subscribed and sworn to before me, this 28th day of February, 1920.

(Seal)

AUGUSTA WHITE
Notary Public,
N. Y. Co.

DISCLAIMER.

Your petitioner, The Permutit Company, a corporation of the State of Delaware, having its principal place of business in the city, county and state of New York, represents that it is the owner of the entire right, title and interest in and to patent No. 1,195,923, dated August 22, 1916, this patent having been granted on an application filed by Robert Gans, of Berlin, Germany, to J. D. Riedel Aktiengesellschaft, of Berlin, Germany, as the assignee of Robert Gans, and having been duly assigned to your petitioner, by an assignment duly executed on the 10th day of November, 1916, by said J. D. Riedel Aktiengesellschaft, and duly recorded January 23, 1917, in the United States Patent Office in Liber K 101, page 411; that it has reason to believe that, through inadvertence, accident or mistake, the specification and first claim of said patent are too broad including that which said Robert Gans was not entitled to claim in said patent.

Your petitioner, therefore, does hereby disclaim from the scope of claim 1 of patent 1,195,923, any water softening apparatus including a layer of zeolites or hydrated alumino silicates disposed on a layer of sand or quartz in which the water to be softened is so introduced into the casing that it passes upwardly through said layer of zeolites.

Signed at the City, County and State of New York, February 26, 1920.

THE PERMUTIT COMPANY,
(Signed) by SAMUEL ROBERT,
President.

(Corporation Seal)

Witnesses:
ARCHIBILD C. MARSH.
ARTHUR C. MARCIANTE.

624 DEFENDANT'S EXHIBIT NO. 43.

* * (Caption) * *

STIPULATION.

It is hereby stipulated and agreed by and between counsel for the respective parties hereto that copies of the testimony of the witnesses hereinafter named, as such testimony appears in the printed Transcript of Record on appeal to the United States Circuit Court of Appeals for the Sixth Circuit in the suit of the Permutit Company vs. Frank L. Wadham et al. and the Borromite Company of America, may be received in evidence in this case with the same force and effect as if said witnesses had been called and had testified herein as set forth in said printed Transcript of Record. The witnesses are as follows:

Francis Payne Mason, commencing on page 282 of said record and ending on page 290, and qualifications on pages 128, 129 and 131.

Adolph Carl Noe, commencing on page 290 and ending on page 295.

Henry L. Nachman, commencing on page 296 and ending on page 297.

625 Felix Stern, on page 298.

Sigmund Waldbett, commencing on page 299 and ending on page 301.

Alfred O. Lee, commencing on page 301 and ending on page 304.

George C. O. Haas, commencing on page 304 and ending on page 315.

Abram Lipsky, commencing on page 315 and ending on page 321.

Otto Luthy, commencing on page 321 and ending on page 327.

Carl V. Bertsche, commencing on page 327 and ending on page 330.

Alfred Mueller, commencing on page 330 and ending on page 343.

Alexander Green, commencing on page 344 and ending on page 356.

Bernard R. Regen, commencing on page 356 and ending on page 369.

John W. Scholl, commencing on page 369 and ending on page 374, and the Exhibits referred to in Scholl's testimony as Complainant's Exhibits 50 and 52, respectively, are included in this stipulation and will be identified as Plaintiff's Exhibits Nos. ..... and .....

COOPER, KERR & DUNHAM,
Counsel for Plaintiff.

WILKINSON, HUXLEY, BYRON & KNIGHT,
Counsel for Defendant.

Sept. 16, 1929.

626 DEFENDANT'S EXHIBIT NO. 45.

* * (Caption) * *

STIPULATION.

It is hereby stipulated and agreed by and between the parties hereto, subject to correction if error appear:

1. That Defendant's Exhibit No. 26 hereto attached is a true enlargement of the drawings appearing in an article in the Techniche Rundschau entitled "Wasserreinigungs-Verfahren mit Permutit" which article is referred to in paragraph 1 of a stipulation heretobefore entered into in this case on September 11, 1929, and marked Exhibit No. 24 and that said enlargement was made subsequent to the issuance of the Gans patent in suit and is on a scale of more than three times the size of the cut as it appeared in the original Technique Rundschau article. It is further stipulated that this enlargement may be offered in evidence, subject, however, to objection as to its admissibility upon all grounds other than that it is such an enlargement.

2. That the copy of the English translations of the German patent law attached hereto and marked Defendant's Exhibit No. 21 and 22 may be accepted as true and correct

translations, for the purpose of this case, and may be received in evidence.

627 3. That the testimony of Lawrence Langner, in the suit of American Chain Company vs. C. G. Spring and Bumper Company, a copy of which testimony is here identified as Defendant's Exhibit No. 23, may be received in evidence with the same force and effect as if said Lawrence Langner were called as a witness and testified in this case; and that the attached extracts from the testimony of Alfred Mueller as it appears in the record on Appeal in the case of Permutit vs. Wadham may be received in evidence in this case as his testimony with the same force and effect as if the said Alfred Mueller had been called and testified herein.

COOPER, KERR & DUNHAM
Counsel for Plaintiff.

WILKINSON, HUXLEY, BYRON & KNIGHT
Counsel for Defendant.

Dated, October 18, 1929.

628 Extract from pages 330, 389 of record on appeal (Sixth Circuit) from Eastern District of Michigan, Southern Division (Detroit) in *Permutit Co.* v. *Wadham et al. and Borromite Co.*

"ALFRED MUELLER, a witness for plaintiff, testifies:

'My name is Alfred Mueller; age 53; I reside in Stamford, Conn.; occupation patent attorney, at No. 565 Fifth Ave., New York City, N. Y.

I was educated in Germany and studied at the Universities of Bonn, Berlin, and Munich, all in Germany. At the latter University, I received the degree of Doctor der Staatswissenschaften after having submitted a treatise on the development of the patent law and its protection in Germany. Then I practiced patent law for two years in Dusseldorf, when in 1899 I came to this country where I continued the practice of patent law making many translations from German patent specifications and publications into English' * * *

'German Gebrauchsmuster do not have the standing or afford the protection which German patents afford. A Gebrauchsmuster is registered in the German Patent Office but is never published. A person desiring a Gebrauchsmuster files a drawing and a written description of that for which he desires Gebrauchsmuster protection and appends to

this description a claim which points out the special feature for which Gebrauchsmuster protection is asked. The protection afforded by the registration of a Gebrauchsmuster is determined by the claim, and does not extend beyond the feature claimed.

The title of the Gebrauchsmuster and the number given it appear in the official publication of the German Patent Office "Patentblatt". Further, the publication of Gebrauchsmuster in the "Patentblatt" is not, however, under the heading of "Patents" (Patents) but under a separate heading "Gebrauchsmuster". Under this heading there appears the number given the Gebrauchsmuster, the title, the name and residence of the applicant, the date of application and the serial number and class. This is everything relating to the registration of Gebrauchsmuster that is published.'" * * *

'Under the German law, such protection as is afforded by the Gebrauchsmuster is for three years, but upon payment of a renewal fee, this protection may be extended for three years more.'"

629 DEFENDANT'S EXHIBIT NO. 46.

* * (Caption) * *

STIPULATION.

It Is Hereby Stipulated and Agreed by the parties hereto that the Gans article, a photostatic copy of which is attached hereto and identified as Defendant's Exhibit No. ..... was published in the printed publication called "Chemische Industrie" on April 15, 1909, and that the photostatic copy may be received in evidence with the same force and effect as the original.

COOPER, KERR & DUNHAM
Counsel For Plaintiff.

WILKINSON, HUXLEY, BYRON & KNIGHT
Counsel for Defendant.

Oct. 19, 1929.

Defendants Exhibit No. 47
(Pages 197-200)

nützlichen Unternehmen. Die angebliche Gesundheitsschädlichkeit der Essigessenz sei als unrichtig wissenschaftlich erwiesen, da die darin enthaltenen Spuren von Mineralsäuren usw. in unseren gewöhnlichen Nahrungsmitteln in viel größeren Mengen vorhanden seien. Gerade der Konzentrationsgrad der Essigsäure in der Essigessenz sei ein Vorzug, weil er die Keimung von schädlichen Mikroorganismen unmöglich mache. Direktor WENZEL beleuchtete als Vertreter des Vereins zur Wahrung der Interessen der chemischen Industrie die wirtschaftliche Bedeutung der Essigessenzfabrikation für andere Industriezweige. Andere Redner, wie Direktor KRELL-Hösel, Dr. BLANK-Berlin, Köchenmeister SCHRIDEGGER von Palmengarten-Frankfurt a. M. sowie zwei Damen, Frau Korvettenkapitän ENGELKE-KRABMANN und Frau GERTRUD HUTH, Vorsteherin in einer Kindervolksküche, bewiesen auf Grund ihrer Erfahrungen, daß die Essigessenz wegen ihrer Reinheit und Bekömmlichkeit nicht nur dem Gärungsessig ebenbürtig, sondern für gewisse Zwecke, namentlich für die Herstellung von Fleischkonserven, wegen ihrer Zuverlässigkeit gegen Gärungserreger vorzuziehen sei. Herr DRESSLER-Dresden gab die Erklärung ab, daß der Deutsche Drogistenverband energisch gegen die Agitation der Essigfabrikanten zur Verdrängung der Essigessenz Stellung nähme. Endlich nahm Herr Professor Dr. LEHMANN-Würzburg das Wort und beleuchtete mit Humor die angebliche Gesundheitsschädlichkeit der Essigessenz, indem er die Mengen der darin gefundenen Spuren giftiger Substanzen, wie Salzsäure usw. mit den unendlich viel größeren Mengen dieser Substanzen verglich, die der menschliche Körper selbst erzeugt oder die im Wein, Leitungswasser und ähnlichen Flüssigkeiten vorhanden sind. Er forderte den anwesenden Professor Dr. ROTHENBACH, auf dessen Untersuchungen die Gegner der Essigessenz sich vielfach bezüglich der behaupteten Gesundheitsschädlichkeit berufen, auf, sofort öffentlich zu erklären, welche gesundheitsschädlichen Stoffe und in welchen Mengen er bei seinen Analysen der Essigessenz gefunden habe, damit man sie sofort auf ihre Zuverlässigkeit prüfen könne. Herr Professor Dr. ROTHENBACH erklärte hierauf, daß er nur anwesend sei, um sich über die Verhandlungen zu *informieren*", daß er sich aber an der Diskussion nicht beteiligen wolle. Auch auf die Ausführungen des Herrn Professor Dr. FRESENIUS-Wiesbaden ging Professor Dr. ROTHENBACH trotz mehrmaliger Aufforderung nicht ein. Die Mitglieder des Verbandes der Essigfabrikanten verließen hierauf die Versammlung, welche nun die Abänderungsvorschläge der Essigfabrikanten einstimmig *ablehnte* und die *Bestimmungen des Nahrungsmittelbuches* in der bisherigen Fassung *bestätigte*. [B. 634.]

Ueber die technische Bedeutung der Permutite (der künstlichen zeolithartigen Verbindungen).

Von
Dr. R. Gans,
Vorsteher des Laboratoriums für Bodenkunde der Königl. Geologischen Landesanstalt, Berlin.

Die Permutite, welche nach meinem Vorschlage[1]) durch Schmelzen von Tonerdesilicaten oder -mineralien, eventuell unter Zuschlag von Quarz, mit Alkalicarbonaten und Behandlung der Schmelze mit heißem oder kaltem Wasser hergestellt werden, müssen, um für technische Zwecke brauchbar zu sein, von körniger, respektive blättriger, leicht durchlässiger Beschaffenheit sein. Aus diesem Grunde werden die obigen Bestandteile in bestimmten Mengenverhältnissen zusammengeschmolzen. Ein Ueberschuß von Alkalicarbonat ist zu vermeiden, da sonst mehr oder weniger schleimige Produkte entstehen. Mit Vorteil ersetzt man einen Teil der hauptsächlich zur Anwendung gelangenden Soda durch Pottasche oder billiger durch Kalifeldspath oder andere kalihaltende Gesteine. Das Korn des Zeoliths wird dadurch größer und poröser, und man erzielt eine höhere Reaktionsfähigkeit der Permutite.

Die auf diese Weise hergestellten Zeolithe enthalten je nach der Schmelzzusammensetzung auf 2—4 Mol. SiO_2 1 Mol. Al_2O_3 neben H_2O, und 1 Mol. Na_2O (respektive K_2O) und einen mehr oder weniger hohen Wassergehalt (30—50 pCt.).

Diese Zeolithe — von mir auch Aluminatsilicate genannt — enthalten ihre Basen in Gestalt von Alkalien und alkalischen Erden an die Tonerde im Molekül gebunden und tauschen dieselben bei Berührung mit Salzlösungen anderer Basen leicht aus. Die Austauschfähigkeit erstreckt sich je nach der Korngröße des Permutits auf einen mehr oder weniger großen Teil des Basengehaltes.

Je höher der Gehalt an Basen ist, desto größer ist die austauschende Kraft der Permutite. Da nun in ihnen auf 1 Mol. Al_2O_3 immer 1 Mol. Na_2O (respektive K_2O) enthalten ist oder mit anderen Worten *der Gehalt an Tonerde bestimmend für den Gehalt an Basen* ist, so ging mein Bestreben dahin, den Tonerdegehalt möglichst zu erhöhen, um damit zugleich auch eine Vermehrung des Basengehaltes zu erreichen. Ein solcher idealer Zeolith soll möglichst der Formel $2\,SiO_2 \cdot Al_2O_3 \cdot Na_2O + 6\,H_2O$ entsprechen, welche Zusammensetzung auch annähernd erreicht wurde.

Auf der leichten Austauschfähigkeit ihrer Basen beruht nun die Verwendbarkeit der Zeolithe für wissenschaftliche und technische Zwecke. Ein weiterer Vorzug der Zeolithe besteht darin, daß alle ihre Salze, auch die der Alkalien, in Wasser unlöslich sind.

Die Verwendungsmöglichkeit der Zeolithe ist eine sehr große und keineswegs auf den reinen Austausch beschränkte. In der folgenden kurzen Uebersicht sind einzelne Beispiele herausgenommen, um die auf den verschiedenen Prozessen basierenden Verwendungsarten zu illustrieren.

I. Prozeß.

Entfernung unerwünschter Basen aus Lösungen durch einfachen Austausch, wobei die nebenher entstehenden Salze wasserlöslich sind;

Stellt man sich aus einem Natriumzeolith, der der Formel $2\,SiO_2 \cdot Al_2O_3 \cdot Na_2O + 6\,H_2O$ gemäß zusammengesetzt sein möge, eine Filterschicht von 50—100 cm her und läßt darüber langsam z. B. eine verdünnte Lösung

[1]) R. GANS, Zeolithe und ähnliche Verbindungen usw. Jahrbuch der Kgl. Geolog. Landesanstalt, Berlin, 1905, S. 179 bis 211.

R. GANS, Konstitution der Zeolithe, ihre Herstellung und technische Verwendung. ebenda, 1906, S. 93—96.

von Calciumchlorid fließen, so entsteht ein Ca-Zeolith und daneben Na Cl, das im Filtrat abgeht:

Formel I. a):

$$2\,SiO_2 \cdot Al_2O_3 \cdot Na_2O + CaCl_2 = 2\,SiO_2 \cdot Al_2O_3 \cdot CaO + 2\,NaCl$$

Durch Waschen mit Na Cl-Lösungen kann man den Ca-Zeolith wieder in einen Na-Zeolith zurückverwandeln. Dieser Prozeß der Regeneration verläuft in ähnlicher Weise wie oben:

Formel I. b):

$$2\,SiO_2 \cdot Al_2O_3 \cdot CaO + 2\,NaCl = 2\,SiO_2 \cdot Al_2O_3 \cdot Na_2O + CaCl_2.$$

Beide Prozesse zogen die Aufmerksamkeit vieler Zeolithforscher auf sich und es sind die Bedingungen, unter denen sie am günstigsten vor sich gehen, durch viele Untersuchungen festgelegt.

II. Prozeß.

Entfernung unerwünschter Salze aus Lösungen, wobei nicht nur die Base, sondern auch die Säure entfernt wird und die nebenher entstehenden Salze wasserunlöslich sind:

Formel II. 1. Beispiel:

$$2\,SiO_2 \cdot Al_2O_3 \cdot CaO + Na_2CO_3 = 2\,SiO_2 \cdot Al_2O_3 \cdot Na_2O + CaCO_3.$$

Formel II. 2. Beispiel:

$$2\,SiO_2 \cdot Al_2O_3 \cdot BaO + CaSO_4 = 2\,SiO_2 \cdot Al_2O_3 \cdot CaO + BaSO_4.$$

Formel II. 3. Beispiel:

$$2\,SiO_2 \cdot Al_2O_3 \cdot Ag_2O + 2\,NH_4Cl = 2\,SiO_2 \cdot Al_2O_3 \cdot (NH_4)_2O + 2\,AgCl.$$

Wir sehen, daß infolge der Unlöslichkeit der gebildeten Salze das unerwünschte Salz vollständig aus der Lösung verschwindet.

Auf diese Art des Austauschprozesses wies zuerst Rümpler hin.[1])

III. Prozeß.

Herstellung von Kontaktflächen durch einfachen und doppelten Austausch zur Ausfällung von Basen aus Lösungen:

Formel III. 1. Beispiel:

$$2\,SiO_2 \cdot Al_2O_3 \cdot Na_2O + SnCl_2 = 2\,SiO_2 \cdot Al_2O_3 \cdot SnO + 2\,NaCl.$$

Formel III. 2. Beispiel:

a) $2\,SiO_2 \cdot Al_2O_3 \cdot CaO + MnCl_2 = 2\,SiO_2 \cdot Al_2O_3 \cdot MnO + CaCl_2$

b) $2\,SiO_2 \cdot Al_2O_3 \cdot MnO + CaMn_2O_5 = 2\,SiO_2 \cdot Al_2O_3 \cdot CaO + MnO \cdot Mn_2O_3$

c) $2\,SiO_2 \cdot Al_2O_3 \cdot CaO + MnO \cdot Mn_2O_3 + 2\,MnH_4(CO_3)_2 = 2\,SiO_2 \cdot Al_2O_3 \cdot CaO + 5\,MnO_2 + 2\,H_2O + 2\,CO_2.$

Der Prozeß (Beispiel 1) dient dazu, um Gold aus verdünnten Lösungen auszufällen. Man erhält eine große Oberfläche von wirksamem Zinnoxydul, welches das Gold nicht durch direkten Austausch, sondern durch die durch das SnO bedingte Kontaktwirkung ausfällt.

Das zweite Beispiel erklärt uns den Vorgang der Entmanganung von Wässern. Bei diesem Prozeß bleibt die entstehende Manganverbindung $MnO \cdot Mn_2O_3$ fest in und am Zeolithkorn haften, sodaß eine große Oberfläche zur Auslösung der Kontaktwirkung, mit welcher hierbei noch eine oxydierende Wirkung verbunden ist, zur Verfügung steht.

IV. Prozeß.

Entfernung von freier Alkalität aus Lösungen.

Die Zeolithe haben die Fähigkeit, freie Alkalität aus verdünnten Lösungen zu adsorbieren und sie bei Berührung mit schwach sauren Flüssigkeiten wieder abzugeben.

Die obigen Prozesse können aber nicht nur zu den genannten Zwecken dienen, sondern gestatten mannigfache Variationen.

So bewirkt z. B. der Prozeß unter I die Konzentration einer in der verdünntesten Lösung befindlichen Base und zwar zunächst in unlöslicher Form durch Anreicherung im Zeolith selbst. Da die Base aber durch konzentrierte Salzlösung aus dem Zeolith wieder austauschbar ist, erhalten wir sie durch diesen Rückaustausch auch in Lösung und zwar in bedeutend konzentrierter als zuvor.

Aus der Formel III, Beispiel 2b, sehen wir, daß der Manganoxydul enthaltende Zeolith quantitativ nicht nur das Calcium sondern auch das Mangan des $CaMn_2O_5$ in sich aufnimmt. Diesen Prozeß kann dazu benutzt werden, um ein Wasser keimfrei zu machen. Versetzen wir ein Wasser mit einer verdünnten $CaMn_2O_5$-Lösung, so sind wir nach erfolgter Sterilisation imstande, durch einfache Filtration über obigen Manganoxydulzeolith das Wasser wieder quantitativ von dem Desinfektionsmittel ($CaMn_2O_5$) zu befreien und es genußfähig zu machen. — Der Zeolith enthält sodann infolge der Oxydationswirkung des $CaMn_2O_5$ höhere Manganoxyde. Das Regenerationsmittel besteht bei diesem Prozeß aus $MnCl_2$-Lösung, durch welche die höheren Manganoxyde in solche von niederen Oxydationsstufen umgewandelt werden, welche wieder $CaMn_2O_5$ zu absorbieren vermögen usw. Ich will hierbei noch darauf hinweisen, daß, je öfter diese oxydierenden und desoxydierenden Prozesse wiederholt und je mehr Mangan aus $CaMn_2O_5$ und $MnCl_2$ der Zeolith dabei aufnimmt, desto größere Mengen keimfreien Wassers der Zeolith gewinnen läßt.

So kann weiter der Prozeß I zur beguemen und fast verlustlosen Herstellung der Salze ein und derselben Base und Säure dienen. Durch Filtration einer Kaliumchlorat- respektive -perchloratlösung über einen Ammoniumzeolith gewann ich reines aschefreies Ammoniumchlorat respektive -perchlorat.

Durch Einwirkung von KCl oder K_2SO_4-Lösung auf einen Na-Zeolith resultierte ein K-Zeolith, aus welch letzterem durch Einwirkung einer Ammoniumcarbonatlösung und Eindampfen des Filtrates fast chemisch reines Kaliumcarbonat erhalten wurde.

Mit obigen Beispielen sind die Verwendungsmöglichkeiten der Zeolithe noch keineswegs erschöpft. Im folgenden seien einige der technischen Verwendungsarten eingehender besprochen.

[1]) Internationaler Kongreß f. angew. Chemie, Berlin, 1903, Bd. 1, S. 59–69.

In der Zuckerindustrie.

HARDY und RÜMPLER waren die ersten, welche eine technische Ausnutzung der austauschenden Kraft natürlicher und künstlicher Zeolithe und zwar für die Zuckerindustrie in Vorschlag brachten. Der dabei in Frage kommende Prozeß besteht in dem Ersatz des Kaliums der Zuckersäfte durch Calcium, da durch wissenschaftliche Versuche festgestellt war, daß Calciumsalze bedeutend weniger melassebildend wirken als Kaliumsalze. Der Prozeß ist also ein reiner Austauschprozeß und wird ausgeführt durch Filtration der Kalium enthaltenden Zuckersäfte über einen Calciumzeolith und Regeneration des letzteren nach seiner Sättigung mit Kalium durch Calciumchloridlösung.

Allein die austauschende Kraft der zeolithischen Silicate HARDYS und RÜMPLERS genügte nicht, so daß ihren Vorschlägen die technische Anwendung nicht folgte.

Die gleichen Versuche mit den bedeutend austauschkräftigeren Permutiten[1]) haben ergeben, daß neben einer Aufhellung der Zuckersäfte und der Entfernung des größten Teiles des Kaliums eine erhöhte Kristallisationskraft der behandelten Zuckersäfte und Melassen erzielt wurde. Das von einigen Fachleuten infolge der Entfernung des Kaliums prophezeite und befürchtete Schwerkochen und Schäumen der Säfte trat nicht ein. Die Versuche sollen in der nächsten Kampagne fortgesetzt werden und zwar wahrscheinlich in einer anderen als der von HARDY und RÜMPLER vorgeschlagenen Form.

Durch Austausch des Kaliums der Melasse gegen Natrium könnte sich eine größere Schmackhaftigkeit und eine für Futterzwecke unschädlichere Melasse[2]) erzielen.

Die Einführung des Verfahrens in die Zuckerindustrie wird im wesentlichen davon abhängen, ob sich noch größere wirtschaftliche Vorteile durch dasselbe erzielen lassen. Um die Kosten für das Verfahren zu decken, wird es meiner Ansicht nach erforderlich sein, daß es neben einer erhöhten Zuckerausbeute gelingt, die durch den Austauschprozeß aus den Zuckersäften herausgeholten Kaliumsalze in irgend einer Form, vielleicht für Düngezwecke geeignet, zu gewinnen.

In der Wasserreinigungstechnik.

Besonders geeignet erscheinen die Permutite für die Enthärtung und Entmanganung resp. Enteisenung von Wasser:[3])

a) Enthärtung:

Der hierbei in Frage kommende Prozeß ist in seiner einfachsten Form ein reiner Austauschprozeß, durch welchen das Calcium und Magnesium des Wassers vom Zeolith aufgenommen und Natrium an das Wasser abgegeben wird:

$$2SiO_2 \cdot Al_2O_3 \cdot Na_2O + CaH_2(CO_3)_2 =$$
$$2SiO_2 \cdot Al_2O_3 \cdot CaO + Na_2H_2(CO_3)_2,$$
$$2SiO_2 \cdot Al_2O_3 \cdot Na_2O + CaSO_4 = 2SiO_2 \cdot Al_2O_3 \cdot CaO + Na_2SO_4$$

Die Regeneration wird durch Waschen des mit Calcium resp. Magnesium gesättigten Zeoliths mit Kochsalzlösung ausgeführt, wodurch wieder ein Natriumzeolith entsteht, der die Enthärtung neuer Wassermengen übernimmt. Es sind schon verschiedene derartige Filter in Gebrauch, teils zur Herstellung von weichem Wasser für Kesselspeisezwecke, teils für Wäschereien.

Die betreffenden Filteranlagen zeichnen sich durch die Einfachheit ihrer Einrichtung aus.

Die Enthärtung ist auch bei kaltem Wasser eine vollständige.

Die Apparatur besteht aus einem eisernen oder hölzernen Filter. Die Höhe der Permutitschicht richtet sich nach dem Härtegrade des betreffenden Wassers und der Filtrationsgeschwindigkeit. Der Nutzeffekt ist umso größer, je langsamer das Wasser durch das Permutitfilter fließt und je feineres Korn die Permutite besitzen.

Die Permutitschicht lagert auf feinem, nach der Tiefe zu gröber werdendem Sande. Nach oben hin wird sie am besten von einem Sandfilter abgeschlossen, das in zirka $^1/_4$ bis $^1/_2$ m Höhe über der Oberfläche der Permutitschicht angebracht ist.[4]) Das Sandfilter wird unter manchen Umständen besser durch ein Kalksteinfilter ersetzt, z. B. bei eisenhaltigen und sauren Wässern. Diese Anordnung des oberen Sand- oder Kalksteinfilters soll weiter verhindern, daß bei Rückspülungen die spezifisch leichten Permutite mechanisch abgeschlämmt werden.

Beispiel: In einer Berliner Fabrik befindet sich eine Anlage zur täglich achtstündigen Enthärtung von 35–40 cbm Kesselspeisewasser von ca. 10 deutschen Härtegraden. Hierfür sind 2 Filter von je 2,4 m Höhe und 1,2 m Durchmesser eingebaut. Jedes Filter enthält ca. 700 kg zentrifugentrockener (450–500 kg lufttrockener) Permutite in ca. 70 cm hoher Schicht. Es ist stets nur ein Filter in Betrieb. Innerhalb der ersten 4–5 Tage liefert das Filter ein Wasser von 0 Härtegraden, worauf die Härte allmählich bis zum 7. Tage auf 4,5–5 Härtegrade steigt. Es wird sodann mit einer Lösung von 150–180 kg mit Holzkohle denaturierten Kochsalzes in 900–1000 kg warmen Wassers regeneriert, die man langsam über das Filter fließen läßt. Am Schluß wird das Filter bis zum Verschwinden der Chlorreaktion durchspült, worauf es zu weiterem Gebrauch fertig steht.

In geeigneten Fällen kann man bei der Enthärtung von Wasser den einfachen Austauschprozeß I mit dem unter IV angegebenen Prozeß vorteilhaft verbinden.

b) Entmanganung resp. Enteisenung.

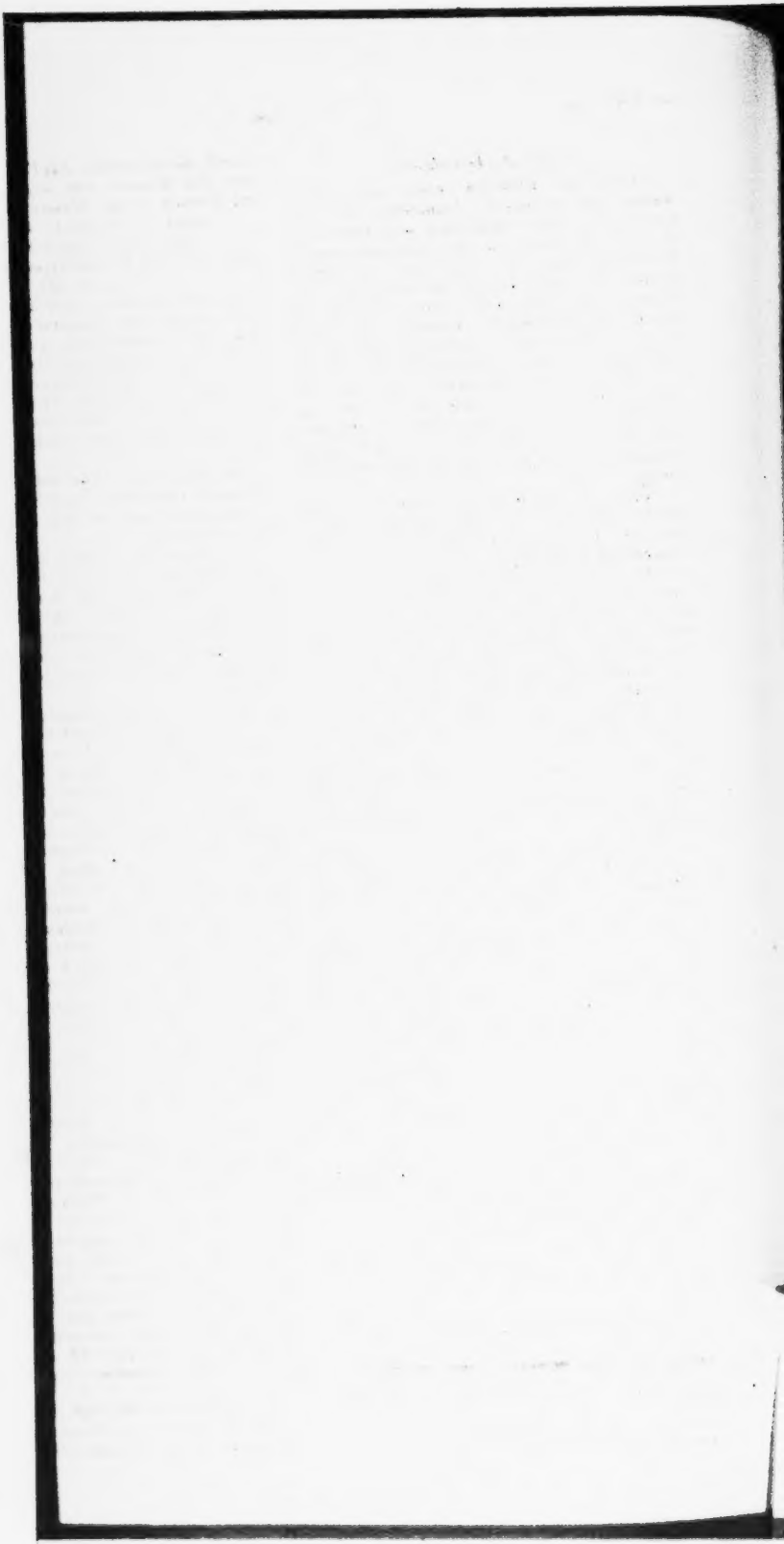
Für die Zwecke der Entmanganung wurden in Glogau 450 kg Calciumzeolithe, die in einem

[1]) H. Hardy und W. Rümpler, Ueber das Verhalten künstlicher und natürlicher zeolithartiger Körper. Chem. Ztg. 1908, Nr. 44, S. 512.

R. Gans, Ueber die Klassifikation der zeolithischen Silicate. Zeitschrift f. d. Zuckerindustrie, XVI. Jahrg., Nr. 14.

[2]) R. Gans, Reinigung der Zuckersäfte von Kali usw. Ztschr. Ver. d. Deutschen Zuckerindustrie, resp. Bd. 57, Heft 613.

[3]) R. Gans, Verbesserung von Trink- und Gebrauchswässern usw. Mitt. a. d. Kgl. Prüfungsamt f. Wasserversorgung und Abwasserbeseitigung. Berlin 1909. H. 8.



eisernen Kessel von 0,95 qm Querschnitt in ca. 0,6 m hoher Schicht lagerten, nach Prozeß III, Beispiel 2, durch Waschen mit Manganchlorürlösung zurrst in Manganzeolithe und darauf durch Calciumpermanganatlösung wieder in Calciumzeolithe übergeführt. Die nebenbei entstehenden höheren Manganoxyde haften mechanisch fest im und am Zeolithkorn. Sie bilden eine große Oberfläche und vermögen infolge der Kontaktwirkung, mit welcher eine Oxydation verbunden ist, eine quantitative Fällung von selbst in größter Verdünnung befindlichen Manganoxydulsalzen auszuführen.

Ueber dieses Filter wurde nun mit der hohen Geschwindigkeit von 22—25 m pro Stunde Trinkwasser geleitet, das im Liter ca. 2 bis 2,5 mg MnO enthielt. Das ausgefällte Mangan setzt sich ebenfalls zum größten Teil fest an das Zeolithkorn an. Zugleich mit dem Mangan fallen auch die letzten Spuren des Eisens aus, die trotz einer vorzüglich funktionierenden Enteisenungsanlage hartnäckig im Wasser verbleiben.

Dieser Eisenschlamm wird täglich durch kurze Rückspülung entfernt.

Wenn durch das ausgefällte Manganoxydul die höheren Manganoxyde in niedere Oxydationsstufen übergeführt sind, mit anderen Worten, wenn das Filter erschöpft ist, wird es durch eine Lösung von $CaMn_2O_3$ regeneriert. Diese Lösung läßt man entweder während der Nacht langsam durch das Filter fließen oder bei Unterbrechung des Betriebes langsam im Filter auf- und abströmen, wodurch in beiden Fällen eine quantitative Absorption des $CaMn_2O_3$ erzielt wird.

Das Mangan aus dem Calciumpermanganat und aus dem Wasser verstärken fortlaufend den Mangangehalt des Filters *und damit seine entmanganende Kraft*, denn alles Mangan wird bei der Regeneration in höhere Oxyde übergeführt.

So wurden beispielsweise von dem Filter bei der ersten Benutzung 80 cbm Wasser entmangant. Nach ca. 12 Regenerationen war jedoch die entmanganende Kraft schon auf 2400 cbm Wasser gestiegen.

Das Filter liefert stündlich ca. 23—24 cbm Wasser, welches frei von Eisen und Mangan, krystallklar und von erfrischendem Wohlgeschmack ist. Die Reaktion ist neutral wie zuvor. Die anderen Bestandteile des Wassers, seine Härte bleiben unverändert. Die Kosten stellen sich bei Verwendung von $CaMn_2O_3$ auf ca. *0,4 Pf. pro Kubikmeter*.

Bei Anwendung von Kaliumpermanganat anstatt des teuren Calciumsalzes stellt sich der Preis auf ca. 0,15—0,25 Pf. pro Kubikmeter. Das $KMnO_4$ gelangt entweder im Gemisch mit CaCl, zur Verwendung, oder es wird vorher durch Filtration über ein besonderes Calciumzeolithfilter in $CaMn_2O_3$ umgewandelt. Diese Anordnung hat den Zweck, eine Aufnahme größerer Mengen Kaliums von seiten des Filters und eine spätere Abgabe an das Trinkwasser infolge Austausches gegen den Kalk des Wassers zu verhüten.

Die frühere Methode, das Mangan durch direkten Austausch aus dem Wasser zu entfernen,[1]) habe ich zu Gunsten dieser prompt und in jeder Beziehung einwandfrei wirkenden Abscheidungsart verlassen.

Die quantitative Abscheidung der letzten Spuren Eisens aus dem Wasser berechtigen zu der Hoffnung, daß man diesen Permutitprozeß auch mit gleichem Erfolg zur Enteisenung von Wasser verwenden kann.

Die oben angeführten Prozesse sind von mir bis jetzt vorgeschlagen, und auf Grund der Resultate von umfangreichen Vorversuchen ist zu erwarten, daß sie mehr oder weniger Eingang in die Technik finden werden. Andere Verwendungsarten sind in Bearbeitung.

Aber ich hoffe weiter, daß nicht nur die technische Chemie sich der Zeolithe wird bedienen können, sondern daß sie bei wissenschaftlichen Arbeiten auch der theoretischen und analytischen Chemie von Nutzen sein werden, besonders in solchen Fällen, in denen die angeführten Prozesse schneller und eleganter als die bisher bekannten zum Ziele führen.

Berlin, den 26. März 1909. [A. 52.]

Neuerungen an chemischen Betriebsapparaten.

Von

F. A. Bühler

in Groß-Lichterfelde

(Schluß.)

In den Figuren 17 bis 20 ist die Ummauerung eines Kessels mit Ablaßventil bei Anwendung von Gasfeuerung dargestellt.

Der Kessel *a* überspannt einen Raum *c*, in welchem die aus dem Schacht *d* aufsteigende Flamme sich frei entfalten kann. Ist sehr hohe Erhitzung von *a* erforderlich, dann empfiehlt es sich, den Kessel möglichst allseitig freischwebend im Feuerraum anzuordnen, um gefährliche Spannungen durch ungleiche Erwärmung zu vermeiden. Wird der Kessel nicht so scharf beheizt, dann kann man ihn auf dem Mauerrande von *c* lagern. Die Heizgase steigen durch kleine Schächte *b* in die Höhe und werden in einem Ringkanal *k* gesammelt, so daß *a* auch noch von der Seite her beheizt wird. Die Gasfeuerung arbeitet mit Ueberdruck, so daß das Heizgas aus der Düse *g* mit entsprechender Geschwindigkeit in die weitere Düse *e* strömt, wo es sich mit der beim Durchstreichen des Kanales *f* vorgewärmten Luft gut mischt. Das Gaszuleitungsrohr *m* ist mit Absperrventilen *l* versehen, welche die genaue Regelung der durch die Stutzen *h* in die Feuerungen strömende Gasmenge bewirken.

Die zur Verbrennung nötige Luft strömt durch die Stutzen *p* in die Kanäle *f*, und deren Menge ist durch Schieber *o* ebenfalls genau regelbar, so daß aus *n* nur das notwendige Quantum austreten kann.

[1]) E. Gans, Reinigung des Trinkwassers von Mangan durch Aluminatsilicate. Chem.-Ztg. 1907. Nr. 18.

666 DEFENDANT'S EXHIBIT NO. 59.

* * (Caption) * *

STIPULATION.

It Is Hereby Stipulated and Agreed by counsel for the parties hereto, that the Weiss thesis entitled "Das Mangan im Grundwasser und seine Beseitigung, Dissertation zur Erlangung der akademischen Würde eines Doktor-Ingenieurs eingereicht am 8. Juni 1909 von Weiss, Stadtbaumeister in Glogau. Mündliche Prüfung am 27. April 1910. Genehmigt von der GroSzherzoglich Technischen Hochschule zu Darmstadt," identified as Defendant's Exhibit No. 60, was published in printed form on June 3, 1910.

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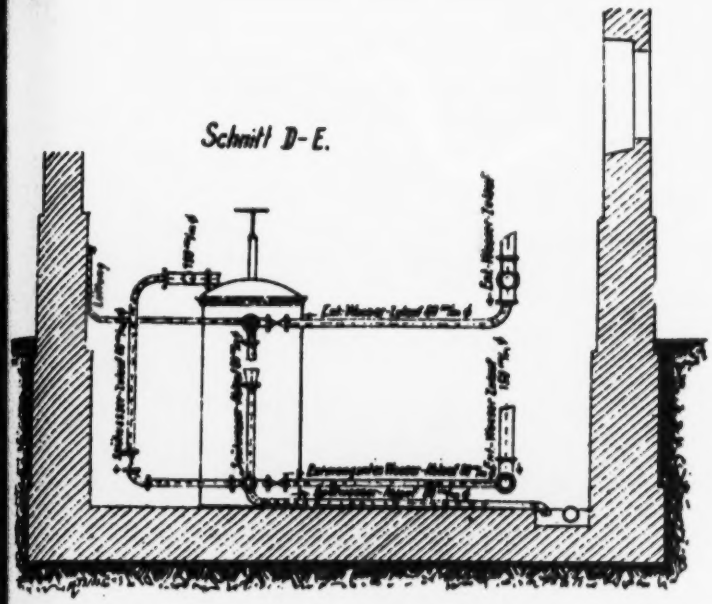
Counsel for Defendant.

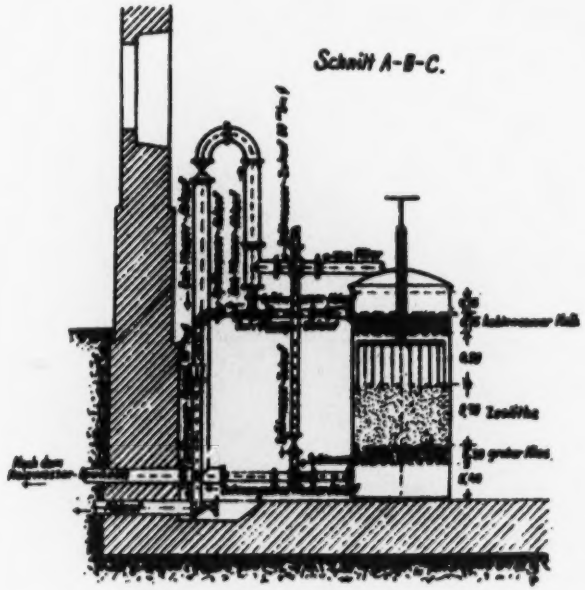
October 25, 1929.

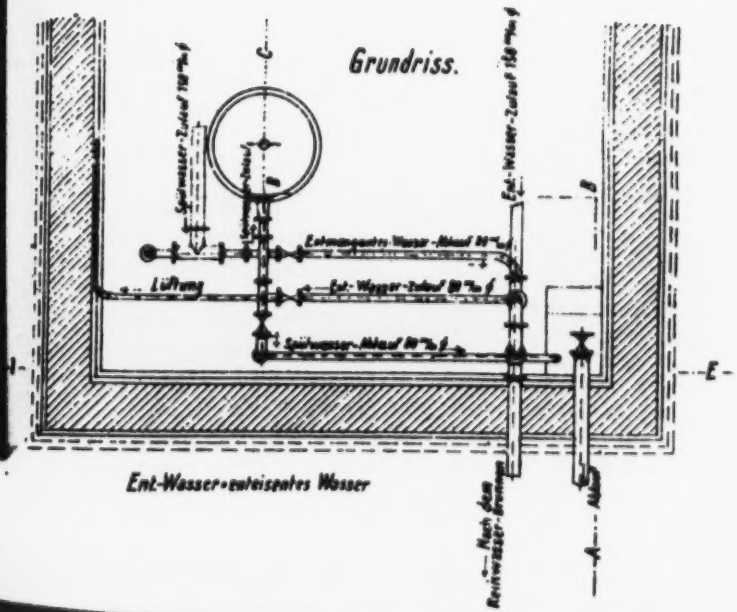
DEFENDANT'S EXHIBIT 60.

667-678 (Weiss Thesis. All German printed matter in this thesis omitted per stipulation filed June 10, 1930. See index.)

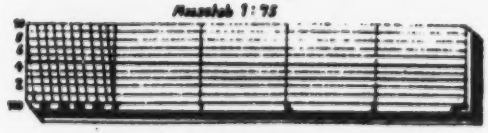
(The following drawings appear in this thesis):







Entmanganungs-Versuchsanlage.



679 DEFENDANT'S EXHIBIT 61.

Title Page.

Manganese in Ground Water
and the Removal of Same

Dissertation
for
Obtaining the Academic Degree of a Doctor of Engineering.
Submitted on June 8, 1909
By
Weiss
City Architect of Glogau.

Oral examination on April 27, 1910.

Approved by the Grand-Ducal Technical College of Darmstadt.

Examiner: Geh. Baurat, Professor Schmitt, Dr. of Philosophy and Engineering.
Co-Examiner: Professor Kolb.

680 5.—The Use of Silicate Compounds.

Other experiments were based upon the property of natural rock of zeolite nature and of artificial zeolite which exchange the bases contained in same against other bases to be found in the water, especially manganese sulfate. In regard to the composition and manner of using these silicate compounds more detailed statements will be made below, but here we will first only discuss the experiments made in Breslau with the substances.

aa) Natural Silicate Compounds.

In the experiments with natural rock of a zeolite nature a weathered porphyry tufa in about lentil-sized grains was used as filtering material, same being furnished for the purpose by factory director Harm. This material, which was comminuted to millet-grain size and screened and showed a silicic acid content of about 72-77%, was given a preliminary treatment with 5% hydrochloric acid, was thereupon washed

out and left to stand for several hours in contact with concentrated lime water. After being washed out for several hours in running system water, the air-dried material was used for filtering, and with a thickness of the layer of 1 meter it gave a water that was fully free from manganese. According to Marshall's reaction, which is extraordinarily sensitive and according to Dr. Lührig indicates quantities as small as 1/100 milligram in 1 liter, the presence of manganese could not be observed. The filtering speed varied in this case between .8 and 6 meter per hour. As a result of a series of experiments it was found that with increasing concentration of the solutions there was also to be found a greater absorptive capacity of the zeolite; the greatest absolute quantitle of manganese sulfate was, however, taken up by relatively thin solutions. If, however, several bases
681 were simultaneously present in the water, the absorptive capacity of the filter also changes.

As soon as the first traces of manganese appeared in the filtrate, a regeneration of the filter with concentrated lime water was undertaken, and then the filtering was begun over again. When the experiments lasted any considerable time, it was found, however, that the periods between the regenerations became ever shorter, as, due to the repeated lime treatment the interspaces between the individual pebbles became clogged, and also because manganese superoxidehydrate had become deposited inside the pores. Neither did an experiment with continuous supplying of lime water give any better results; the filter even became clogged earlier; On the other hand, through a treatment of the silicates with a concentrated solution of $CaCl_2$ only a part of the absorbed manganese could again be brought into solution through exchange. The removal of the deposited manganese superoxidehydrate by means of flushing or some other mechanical treatment proved to be out of question. As a result of these experiments, Dr. Lührig therefore states:

1. that the absorptive capacity of natural zeolite for manganese sulfate is limited,
2. that a regeneration by means of lime water is possible,
3. that thereby, however, the rapid clogging of the filter layer is brought about.

The purifying of manganese-containing waters in the above described manner Dr. Lührig, therefore, declares to be on the whole impracticable, first, because the slight absorptive capacity of zeolite for manganese salts for economic reasons does not permit a direct use of this sort of rock, and because,

on the other hand, through the precipitation of manganese sulfate as an insoluble oxidehydrate the clogging of the layer is brought about.

bb) Artificial Silicate Compounds.

As a material of considerably higher exchange capacity
682 the artificial zeolite first made by Dr. Gans was established. The conduct of the latter is quite similar to the conduct of natural zeolitic rock, the two differing only in the strength of the exchanging power which in the case of the artificial silicate is up to about ten times as great as in the case of the natural rocks. Extensive experiments were therefore carried out also with this material. According to the experiences that Dr. Gans had gathered in the laboratory in regard to the method, it was necessary, before the demanganizing, to obtain a complete deferrizing and deacidizing, for instance, through an addition of carbonate of lime; 1 kilogram permutite was then able to purify about 2.3—4.5 cubic meter water of a manganese content of 10 milligram to 1 liter, before it was necessary to undertake a regeneration. The regeneration was obtainable, for instance, by means of a solution of calcium chloride. As 1 kilogram permutite costs about Mk. 1.50, the costs for 1 cubic meter purified water would, according to Dr. Lührig's calculation, amount to about 33 Pfennig, under the assumption that 4.5 cubic meter can be purified with same the first time. The above experimental results found by Dr. Gans in the laboratory were subjected to a supplementary test in Breslau. Here it was found that silicate as a means took up from various treatments with $MnSO_4$ about 3—4% of this substance, which was each time again partially removed from the permutite by subjecting it to the influence of a 15% solution of calcium chloride. From these experiments follows that manganese sulfate is taken up in exchange against other bases by permutite, and this mostly in so much the greater degree, the stronger the solution is, in which connection the time of the influence does not seem to play any essential role. A complete exchange ability does not exist, however, at usual temperature, in spite of frequent treatment with strong salt solutions. The absorptive capacity of the substance is relatively and absolutely great if the manganese sulfate is slowly filtered through the silicate in very thin solution; on the other hand, the
683 presence of considerable quantities of other bases in the solution has a disadvantageous influence on the absorptive capacity of the permutite.

In order to test these relatively favorable results also on a large scale, further extensive experiments were arranged at the waterworks in Breslau. 10—12 cubic meter water with a content of 10 milligram manganese sulfate per liter were here filtered at the speed of 1 meter through a layer of permutite about 15 centimeter thick and with an area of about 1 square meter. After the filter had been in operation for some time, the filtered water proved to be practically free from manganese, and in regard to taste it had undergone no change. Gradually, however, the filter grew less permeable, as manganese superoxide had become deposited throughout the whole mass, whereby the filter became clogged. The silicate had set alkali free in exchange with the bases of the water, which, according to the opinion of Dr. Lührig, had to be removed. Although this is possible only through a mechanical treatment, for instance, through an intensive washing, nevertheless the material is not in the long run able to stand such a treatment. Dr. Lührig also declares the regenerating of the filter to be on the whole impracticable, as large supplies of lye are required, whereby also great outlays would have to be made for new installations; in his opinion, the costs and inconveniences of the method therefore are in no reasonable proportion to its advantages. As from May 31 until August 27, 1907, that is, until the filter started to become clogged, with an approximate speed of 1 meter, a total of 583 cubic meter water had become liberated from the manganese, the costs of the method would therefore amount to about 31 Pfennig for 1 cubic meter. The results of these tests therefore gave no justification for harboring any great hopes; nevertheless, Dr. Gans immediately made vigorous contradiction of this method of calculation.

684 6.—A Combined Method.

The difficulties caused, on the one hand by the lime water method in regard to the taste deterioration of the water, and, on the other hand, by the method using silicate compounds as auxiliary means, in that it clogged up the filter, caused Dr. Lührig to take as a basis for further experiments a combination of these two methods. In this combination the manganese sulfate is precipitated by means of lime water in a slight excess from the water and then brought into clearing basins for settling. In order to remove the then remaining traces of free caustic lime, the still weakly alkaline water,

freed from soluble manganese salt, is filtered through a silicate layer. In the Breslau experiments Dr. Lührig used for this purpose a filter of natural zeolitic rock having a surface of about 1 square meter and a height of about 75 centimeter, which rock was preliminary treated as above described. The water purified in this manner contained neither manganese nor iron compounds and showed no detrimental effect as regards taste. As, further, the deposits were held back in the clearing basin, no reduction of the filter output took place, wherefore it was possible to demanganize approximately 3000 cubic meter water with the same filter. In regard to the chemical processes that took place in that connection, as well as in regard to the economic side of the question no more detailed data were obtainable.

From the above described thorough experiments Dr. Lührig draws the conclusion that, for Breslau, the most advantageous thing to do is to carry out the division of the conveyed water according to the different groups and treat the good water as before, but liberate the infected water in a new plant from its iron content. For the demanganizing of this deferrized water Dr. Lührig recommends an automatic addition of concentrated lime water which, according to the above explanation, will bring about a complete removal of the manganese. The water is to be cleared through sedimentation and by passing it through a layer of gravel, and is then to be freed from its excess of caustic lime by mixing it with good water.
685 This method is supposed to be the cheapest method of demanganization without any noticeable deterioration of the taste of the water, as the caustic lime has proven to be the simplest and cheapest means for this purpose. For 40000 cubic meter water with 10 milligram manganese sulfate to 1 liter of water, 3½ cwt. caustic lime are sufficient so that at a price of Mk. 1 per cwt., an expenditure of only Mk. 3.50 would have to be made daily.

Of the methods tested in Breslau only the combined method described under 6, that is the one last mentioned, would probably be suitable for operation on a larbe scale. In both cases, however, the addition of caustic lime will bring with it great difficulties in regard to a positively sure dosing of same and in regard to a reliable supervision of the plant, so that a sufficient guarantee for the furnishing of a hygienically always perfect drinking water is not given. Besides, the combined method would, probably, require not inconsiderable expenditures, and on the other hand, the last described method

—the mixing with good ground water—would not always furnish a water that is unobjectionable also from the standpoint of taste.

From what has been said it is therefore apparent that up to the time of the Breslau experiments, and even through these, it was not possible to find the proper measures for liberating a ground water in a satisfactory manner from its content in manganese, whether it be in the ground itself or first after raising it. None of the methods that have hitherto come under investigation has proven equal to the demands of hygiene, industry and economy in an equal manner, but failed in most cases when the strict measuring standard of praxis was applied to it. Especially have difficulties turned up in the experiments hitherto made to remove the manganese so that really not the least bit of it remains, without in that connection injuring the taste of the water in one way or another, and of all the above described methods not one can be recommended for practice on a large scale without special limitations.

686 d) The New Method of Dr. Gans.

First through the experiments carried on on a larger scale at the cupola waterworks of the city of Glogau did it become possible to prove that with a new method of Dr. Gans and through the use of artificial zeolite compounds all the demands were met that must be made on such a method.

1. The Nature of the Materials Used and Their Method of Functioning.

Before we enter into closer details of the experiments, however, the nature and the manner of functioning of the materials used will first be discussed a little more extensively. The composition of the zeolite is described by Dr. Gans in the Year Book of the Royal National Geological Institute from the year 1906, and from this report we take the following:

The permutities are, according to Dr. Gans' proposal, made through the melting of aluminate silicates, eventually with addition of quartz with alkali carbonates and treatment of the melted material with hot or cold water. In order to serve as material for the filter, these substances must be of a grainy and easily permeable nature, and in melting it is therefore necessary to avoid an excess of alkali carbonates, as otherwise products of a more slimy nature are created. These

zeolites contain their bases in the form of alkalies bound to the lumina and easily exchange the latter through contact with the salt solutions of other bases, especially metal salts. This exchanging power of the permutites grows with the contents in bases, and as this content is, in its turn, determined in the first place by the content in alumina, Dr. Gans sought to increase the contents of alumina in the silicates to the greatest possible extent. He succeeded in composing such a nearly ideal zeolite of the formula:

$$2\ SiO_2\ .\ Al_2O_3\ .\ Na_2O + 6\ H_2O$$

These artificial compounds producel by Dr. Gans show
687 a considerably higher exchange capacity than all silicate compounds occurring in Nature, and due to their structure they are, besides, specially suited to serve for filtering purposes, as they are extraordinarily permeable to water. The artificial zeolites are brought on the market by the firm Riedel, Berlin, under the name of "Permutit" (Permutite), and these unite in themselves all the advantages for the purification of water, as they pass no alkalinity to the water and exchange all undesirable bases from the water even at considerably water speeds. The use possibilities of filtration through aluminate silicates, as Dr. Gans has named these compounds, are according to him as follows:

1.—To purify water of iron and manganese by filtering same through calcium aluminate silicate.

2.—To take away the full hardness from a hard water, or part thereof, by passing same through a filter of sodium aluminate silicate, whereby aht the same time also iron, manganese and ammonia are extracted from the water.

3.—To extract from the water, the hardness of which principally depends upon the lime of the calcium sulfate, its gypsum contents, in that it is passed in succession through a strontium aluminate silicate filter and a calcium aluminate silicate filter.

In regard to the deferrizing of a water it should be mentioned that the method has the advantage, as compared with the methods now used, that water can be sent through the calcium aluminate filter, with air excluded, without being brought in contact with the air and the bacteria germs.

Here we are, of course, interested only in the phenomena coming under fig. 1 above, and below the manner of functioning of the zeolites in this respect will be given a more detailed

consideration. While Dr. Gans in the above described
688 Breslau experiments brought into use only the simple exchange of the bases in the calcium aluminate silicates for the purpose of purifying the water of manganese, and while there the regeneration of the filter tok place by means of sodium chloride or calcium chloride, Dr. Gans later changed his method in favor of a better manner of functioning of the zeolites. This new method of his consists in the producing of contact surfaces on and between the zeolites through the forming of insoluble higher manganese oxides which adhere to the zeolite grain. In this manner a surface is formed which assures a high contact effect and exercises a strong oxidizing effect, so that under the influence of a thus prepared filter a quantitative precipitation of the manganese oxidous salts is immediately obtained in the filtering regardless of whether the salts are contained in the water strongly diluted or in large quantities.

According to the statements of Dr. Gans the process that takes place in this new method is the following:

First it is necessary to convert a part of the calcium zeolites into manganese zeolites through a preliminary treatment with manganous chloride. The formula for same is as follows:

$$1.—2\ SiO_2\ .\ Al_2O_3\ .\ CaO—MnCl_2—$$
$$2\ SiO_2\ .\ Al_2O_3\ .\ MnO—CaCl_2$$

The thus formed manganese zeolites are changed back into calcium zeolites through treatment with a diluted permanganate solution, preferably by means of calcium permanganate, when they will form higher manganese oxides which adhere to the surface of the zeolite as MnO Mn_2O and exert the above described contact effect. As the formula for this effect of the permanganate solution Dr. Gans gives

$$2.—2\ SiO_2\ .\ Al_2O_3\ .\ MnO — CaMn_2O_8$$
$$2\ SiO_2\ .\ Al_2O_3\ .\ CaO — MnO\,.\,Mn_2O_7.$$

689 The filter layer prepared through this treatment with a permanganate solution is now suitable for absorbing the manganese compounds from the through-filtering water that is to be purified. Through the above described contact action the manganese is separated from the water in passing in the form of manganese oxides of the lower oxide stages. The process which takes place in that connection is explained through the following formula:

$$3.\ 2\ SiO_2\ .\ Al_2O_3\ .\ CaO + MnO\ .\ Mn_2O_7 + 2\ MnH_2(CO_3)_2 =$$
$$2\ SiO_2\ .\ Al_2O_3\ .\ CaO + 5MnO_2\ 4 + CO_2 + 2\ H_2O.$$

As will be seen from these formulas the zeolites play more of a secondary role as carriers of the actual active manganese compounds. As such they appear especially suitable on account of their grainy structure as well as on account of their permeability to water, and in their case the forming of active contact surfaces takes place with ease. In the experiments of Dr. Gans in the laboratory it was found that during an extended operation after the regeneration an increase took place in the demanganizing power of the filter, said increase being mostly about one and one-half times that of the preceding period. As a condition for the regular occurrence of these processes is to be considered that the water to be purified shows a weekly alkaline reaction, which however, is removed through the filtering, so that afterwards a fully neutral water results. No change is in any way brought about through this method in the taste of the water. The experiments that Dr. Gans had carried on in the laboratory, namely with the water from the Berlin waterworks system, in the separating of iron, and with water to which a quantity of 10 milligrams of manganese sulfate per liter of water had been added for separating the latter substance, had shown that this method was apt to meet all the demands that could be put on the purification, especially also the demand for economy. But in order to establish the usability of the method in praxis, experiments must be carried out on a greater scale.

690 2. The Glogau Experimental Plant and the Results Obtained with Same

For these purposes the newly erected waterworks of the city of Glogau seemed particularly well suited, first, because the water here conveyed, in addition to an extremely heavy content of iron (up to over 20 milligram per liter), also showed a heavier content in manganese, and, on the other hand, because in building the works the adding of a demanganizing plant had been taken into consideration. The building of the Glogau waterworks consists of four stories, of which the lowest one is intended for the demanganizing plant. Above the latter is located the deferrizing plant which in three rooms contains, one below the other, two coke strainers, two sediment containers, and three rapid filters (with peral gravel filling). As will be seen from the attached analyses in annex 1, the deferrizing plant works with absolute sureness, after it has now been in operation for a consider-

able time past and removes the iron from the water with the exception of traces thereof.

The sediment container is so arranged that in case of need a filter of carbonated lime can be inserted, for the purpose, in case of necessity, to effect the deacidifying of the water, but this need has up to the present time not appeared.

For the carrying out of the demanganizing experiments the firm David Grove, Berlin, which had also executed the other new installations for the waterworks, had set up a round boiler, about 2 meter high and with a bottom surface of about .95 of a square meter, and in this boiler the filtering installation was placed. As will be seen from the attached drawing, there is placed in the bottom of the boiler a bottom of a woven fabric which carries a gravel layer 20 centimeter high. On this gravel layer is placed the zeolite filter, properly speaking to a height of about 70 centimeter, containing about 450 kilogram calcium zeolites, and above the latter, at a distance of 50 centimeter, there is double layer of a fabric which
691 has a layer of marble pieces between the two layers of fabric. This lime filter serves for the purpose of, first, bringing about the possibly required deacidifying of the water, and, on the other hand, to prevent the washing away of the permutite in case of uncautious back-flushing.

The boiler is provided with a pipe connection at the top and at the bottom and has been provided with a number of water gauges of glass, in order to make it possible to observe the momentary level of the liquid and the nature of the latter. The upper pipe connection is, first, joined to the collecting line for the deferrized water and has, further, received an outlet line, while the lower pipe connection is connected to the pure water pressure-line back of the pressure pump and is also provided with an outlet line. Another pipe connection in the top of the boiler makes it possible to add chemicals to the filter and further permits the loosening up of the zeolite layer by means of the stirring device also shown. This stirring device is brought through the top in the manner of a stuffin-box, so that the filter can work also with internal overpressure.

On October 20, 1908, the filter was first subjected to a preliminary treatment. Through the filtering a manganous chloride and calcium zeolites were partly changed into manganese zeolites and thereupon back into calcium zeolites through a treatment with a permanganate solution. The latter hold the higher manganese oxides also formed in this

process mechanically bound at their surface and in their grain. After the flushing out of the filter it was ready for use.

Through this filter the deferrized water was sent with a speed of about 20 meter per hour, which speed was further increased in the course of operation. This water which was then still mixed with slight quantities of iron (about .2 milligram per liter), contained at this time about 4 milligram MnO per liter, a content which in the course of operation at times went down to about 2 milligram per liter. The 692 filter was left in operation until the first traces of manganese could again be found in the water with the aid of the Marshall reaction. In this first filtering period this occurred after four hours; in that time about 80 cubic centimeter of water had been filtered, and as the addition of calcium permanganate had amounted to 2 kilogram, the resulting figure gave a water quantity of 40 cubic meter for 1 kilogram of calcium permanganate.

In this connection it is to be noted that the water quantity during the first days was determined through a direct measuring of the discharge by means of a vessel, while for the fifth filtering period onward the water quantity was determined in a more accurate manner through a water meter that had in the meantime been installed.

After the close of the first filtering period, and on the day following, that is October 21, 1908, a regeneration was effected with 1 1/2 kilogram calcium permanganate. Hereby was obtained a filtered quantity of 120 cubic meter water, so that the resulting average output was 80 cubic meter for 1 kilogram of calcium permanganate. In these experiments on a large scale the same facts were thus established as had already been observed in the laboratory experiments of Dr. Gans, namely that the demanganizing power of the filter steadily grows during the first stage. Also during the third and following filtering periods this observation was confirmed, in that the experimenters succeeded, from January 15th to February 2nd, 1909, to demanganize within 120 hours and with an addition of 4 kilogram calcium permanganate 2571 cubic meter water. The filter, which here probably had reached its climax, thus gave, during this period, an average output of 642 cubic meter for 1 kilogram of calcium permanganate.

This favorable manner of functioning of the filter is a result of the fact that the manganese sludge separated from the

water is not elutriated after the exhaustion of the filter, but left on same. In the course of a ten-hour operation pe-
693 riod about 1 kilogram $MnSO_4$ is added, to which later comes, at the regeneration, manganese sludge in the amount of .66 kilogram $MnSO_4$. Thus, if the filter is not loosened up, the permeability of same becomes with necessity smaller. But if such a loosening up is effected in the proper manner, the first deposited, sharply defined manganese flakes become enlarged through later precipitated flakes and form small porous grains which do not unfavorably influence the filteration speed. This loosening up of the filter, which has to be undertaken once every day is in a simple manner effected through back-flushing in connection with the action of a rotatable stirring mechanism of iron. As the cohesion between the filtering parts baking together is a very loose one, it is easy to again make the filter capable of operating for a whole day by rotating the stirring mechanism once and flushing for about a minute. As, besides, the filter separates not only the manganese but also the small quantities of iron remaining in the water after the deferrization, with the exception of a last remainder, there is formed on the filter surface a thin layer of separated iron sludge. This layer can easily be removed through a brief elutriation in connection with the back-flushing. The water consumption for the loosening and the flushing after the regeneration amounts to only .5 to 1% of the filtrate, thus being very small.

The above described measures for the loosening up of the filter proved to be entirely sufficient in permanent operation. No thickening of the filter occurred, although at the termination of the experiments about 2400 cubic meter water had been purified through one and the same filter and during that time about 180 kilogram manganese sludge had formed on the filter as $MnSO_4$. The filtering speed could therefore not only be maintained to the end at the original 20 meter, but could easily be increased to 25 meter per hour. In this connection it is to be noted that in the Breslau experiments a filter of the same cross section was declared entirely clogged after a
694 deposit of 5.85 kilogram $MnSO_4$. In normal operation the regeneration can best be effected, with avoidance of a stoppage of operations in the day time, in the manner that the regeneration fluid is supplied to the filter in the evening after the close of operation and then allowed to slowly filter through same during the night. There then remains only to wash the filter through, in order to have it ready for operation. Should

it, however, be required to speed up the regeneration, this can be done by allowing the fluid to pass up and down several times in the filter. In this manner it was possible to make the filter ready for use again in about one hour. In both cases, a complete absorption of the $CaMn_2O_8$ was obtained.

As the demanganizing power of the filter was increased in the described manner, it was possible to make the change of adding only as much permanganate solution as was necessary for operation during a week. In later permanent operation it will therefore be possible to demanganize with the one filter about 1200 cubic meter water during six operating days of ten hours each, with an addition of about 4 kilogram calcium permanganate. In this manner one would get along with carrying out the regeneration of the filter only once a week.

In order to make possible a more rapid increase in the demanganizing power of zeolite filters to be made in the future, one will make use of concentrated manganese solutions which can be reduced artificially. In this matter it will be possible to satisfactorily prepare the filter in a short time, say in 4-6 days.

3. The Costs of Demanganizing.

The current costs of a demanganizing plant according to the described system will in normal operation be directly proportional to the varying manganese content of the water, and will be the more favorable, the higher the demanganizing power of the filter is. In the annexed list 3 the average cost of regeneration for a cubic meter of purified water at the Glogau experimental plant is calculated for the separate filtering periods and shows, in general, a decrease with the increase
695 in the demanganizing power of the filter, the decrease being from .4-.2 Pfennig per cubic meter. Here the present price of Mk. 1.20 for 1 kilo calcium permanganate is taken as a basis. Taking into consideration the costs required for the flushing and for the operating service, one would, therefore, be able to effect a demanganizing of water, which like the Glogau water contains about 2-3 milligram MnO, with the expenditure of about .4 Pfennig per cubic meter in current costs. Hereto would further have to be added interest and amortization of the invested capital, which, however, due to the extraordinarily high output capacity of the filter, can be estimated at a very low figure and set at about .2 Pfennig for 1 cubic meter of purified water. The total cost per cubic meter of purified water would therefore amount to about .6

Pfennig per cubic meter and would remain approximately the same for small and for large plants.

An essential cheapening of the process can probably be attained through the use of other permanganate salts especially Potassium permanganate, or sodium permanganate. But experiments in that direction have not yet been concluded. The expenditures necessary for regeneration would, in this case, be reduced to .15-.2 Pfennig per cubic meter, so that the total cost would thereby be reduced to .45-.50 Pfennig per cubic meter.

4. The Advantages of the Method.

On page 36 we have discussed the demands that are generally made on a method suitable for the removal of the manganese. We will now once more state in detail in what manner the above described method fulfills these conditions.

1. The removal of the manganese from the properly pretreated water takes place in a quantitative way, regardless of whether the solution is very strongly diluted or rich in manganese compounds.

2. The separation of the mangenese from the water takes place instantaneously in filtering through the filter. As
696 the latter, besides, possesses a high degree of permeability, it permits of an extraordinarily great filtering speed. The advantages resulting therefrom are: small space requirements, small installation and operation costs, and the accessibility for inspection of the plant.

3. As the filtering body can be arranged in a completely closed container and the regeneration with premanganate shows a bacteria-killing effect, the method can be considered free from objections in a biological respect. Nor does any unfavorable influence or change of the flowing water take place in a chemical respect, but the purified water is, on the contrary, perfectly neutral, crystal clear, and has a refreshingly good taste; nor is it changed in any way in regard to hardness and its other chemical ingredients.

4. As above demonstrated, the total costs for demanganizing a water with a content of 2-3 milligram MnO per liter, with the use of calcium permanganate, will amount to about .6 Pfennig per cubic meter of purified water and can, probably, be reduced to .45-.50 Pfennig per cubic meter, with the use of other permanganate compounds. In view of the above indicated, quite high manganese content, and in view of the

other advantages of the method, these costs may be characterized as very low.

5. As the regeneration of the filter is required only weekly and the flushing and loosening up only once daily, and as, furthermore, these manipulations can be carried out very simply and rapidly, the requirements of operating services are reduced to a minimum and can be fulfilled also by an unskilled crew, which can in a short time be made familiar with the handling of the plant.

697

As another advantage of importance not to be underestimated should further be mentioned that the demanganization filter can be connected behind the pumps in the pressure line, whereby the whole installation cost and the increased current costs are eliminated that would be required for a double raising of the water. This circumstance will have special weight in cases where, in addition to the manganese compounds, also small quantities of iron must be removed from the water. In this case it would be superfluous to install a special deferrizing plant, whereby consequently installation and operating costs of the purifying plant would be considerably reduced.

No.	Object of the Investigation	Analysis:	1	2a	2b	3	4
		Drawn on	11/2/07	11/19/07		11/16/07	3/12/07
		Analyzed by	Dr. Luhrig	Dr. Luhrig		Dr. Gans	Dr. Mahenholz
		Kind of Water	Natural	Nat.	Deferrized	Natural	Natural
1.	Dissolved substances		175.2	.	.	181.5	178.0
2.	Loss on ignition		16.0	.	.	14.5	18.0
3.	Residue on ignition		159.2	.	.	167.0	160.0
4.	Chlorine (Cl)		5.6	.	.	10.7	11.6
5.	Silicic acid (SiO_2)		14.8	.	.	16.4	15.9
6.	Sulfuric acid (SO_3)		6.7	.	.	1.1	14.4
7.	Nitric acid (N_2O_5)		.....	.	.	No traces	No traces
8.	Nitrous acid (N_2O_3)		.....	.	.	No "	No "
9.	Bound carbonic acid (CO_2)		.	.	.	77.7	.
10.	Free Carbonic acid		.	.	.	.	.
11.	Lime (CaO)		52.4	.	.	56.2	60.0
12.	Magnesium (MgO)		6.4	.	.	6.8	6.7
13.	Alumina (Al_2O_3)		.	.	.	5.2	.
14.	Alkalies (Na_2K_2O)		.	.	.	21.8	.
15.	FERRIC OXIDE (Fe_2O_3). Total		14.3	.	.	17.2	17.0
	Remaining in solution		.	.	.	.	.
	Separated as sediment		.	.	.	.	.
16.	MANGANESE (MnO)		4.0	2.1	2.3	1.7	1.8
17.	Ammonia (NH_3)		.....	.	.	.	.
18.	Oxidizable organic substances						Deferr. water
	Consumption of potassium permanganate		12.8	.	.	13.8	6.95
	Consumption of oxygen		.	.	.	.	.
19	Harness in German degrees						
	Total		5.2°	.	.	6.6°	5.8°
	Permanent		2.8°	.	.	3.1°	3.0°
	Vanishing		2.4°	.	.	3.5°	2.8°
20.	Reaction		neutral not noticeably alkaline	.	.	very weakly alkaline brownish cloudy	weakly alkaline weakly brownish
21.	Appearance		.	.	.	.	.
22.	Water gauge at Street Bridge in Glogau +meter		.	.	.	.	.

NOTES: The figures given under No. 1—18 signify milligram per 1 liter.
"." means "not analyzed"
"....." means "not demonstrable
Mean low water: +' .47 meter.
Mean water: † 1.71 meter.
Highest water: † 5.70 meter.

II

THE CUPOLA WATERWORKS OF THE CITY OF GLOGAU (ANALYSES)

Object of the investigation	Analysis:	5a	5b	5c	6a	6b	6c
	Drawn on:	10/9/08			10/9/08		
	Analyzed by	Dr. Luhrig			Apothecary Jantke		
	Kind of Water	Nat'l	Dissolved	Deferrized	Nat'l	Dissolved	Deferrized
1. Dissolved substances		204.0	196.0	183.5	.	.	.
2. Loss on ignition		25.5	28.0	22.5	.	.	.
3. Residue on ignition		178.5	168.0	161.0	.	.	.
4. Chlorine (Cl)		11.0	11.5	11.0	10.65	10.65	.
5. Silicate acid (SiO_3)		.	.	.	.	.	.
6. Sulfuric acid (SO_3)		17.8	18.1	18.4	small quant	.	small quantities
7. Nitric acid (N_2O_5)		minimal traces	.	.	.	.	.
8. Nutrous acid (N_2O_3)		not	found	. . . .	free	free	free
9. Bound carbonic acid (CO_3)		.	.	.	.	.	.
10. Free carbonic acid		.	.	.	.	.	.
11. Lime (CaO)		62.4	62.4	63.2	.	.	.
12. Magnesium (MgO)		12.8	14.2	13.3	.	.	.
13. Alumina (Al_2O_3)		.	.	.	.	.	.
14. Alkalies (Na_2K_2O)		.	.	.	.	.	.
15. FERRIC OXIDE (Fe_2O_3) Total		18.1	6.9	0.12	7.0	2.5	0.2
Remaining in solution		.	.	.	.	.	.
Separated as sediment		.	.	.	.	.	.
16. MANGANESE (MnO)		4.8	6.5	5.1	.	.	.
17. Ammonia (NH_3)		traces	traces	traces	traces	traces	traces
18. Oxidizable organic substances Consumption of potassium permanganate		21.5	14.4	8.5	16.2	15.9	7.1
Consumption of oxygen		.	.	.	.	.	.
Harness in German degrees Total		8.04°	8.23°	8.18°	8.2°	7.4°	5.4°
Permanent		"	"	"	"	"	"
Vanishing		.	.	.	.	.	.
Reaction		alkaline	alkaline	alkaline	Yellowish opalescent neut.) weak odor of unclean hydrogen	Yellowish opalescent neutral odorless	Clear colorless odorless neutral
Appearance		red brown (cloudy with plain red-brown sediment)	yellowish cloudy with slight yellowish	odorless clear without any sed. in air.			
Water gauge at Street Bridge in Glogau + meter		1.03	1.03	1.03	1.03	1.03	1.03

NOTES: The figures given under No. 1—18 signify milligram per 1 liter.
" " means "not analyzed"
" . . . . " means "not demonstrable
Mean low water: + .47 meter
Mean water: † 1.71 meter
Highest water: † 5.70 meter

III

700 THE CUPOLA WATERWORKS OF THE CITY OF GLOGAU
(ANALYSES)

No.	Object of the investigation	Analysis:	7a	7b	7c	8a	8b	8c	8d
		Drawn on:	9/28/1908			1/20/1909			
		Analyzed by	Engineer Brauer			Dr. Luhrig			
		Kind of water	Nat'l	Dissolved	Deferrized	Nat'l	Dissolved	Deferrized	Demanganised
1.	Dissolved substances		.	.	.	236.8	214.0	206.8	208.4
2.	Loss on ignition		.	.	.	23.6	16.0	13.6	13.6
3.	Residue on ignition		.	.	.	213.2	198.0	193.2	194.8
4.	Chlorine (Cl)		11.0	11.0	11.0	11.27	11.27	11.27	11.27
5.	Silicic acid (SiO_2)		.	.	.	17.2	.	.	.
6.	Sulfuric acid (SO_3)		41.2	43.0	43.0	32.8	31.8	31.1	30.6
7.	Nitric acid (N_2O_5)		traces	traces	traces	. . . .	. . . .	. . . .	. . . .
8.	Nitrous acid (N_2O_3)		traces	traces	traces	. . . .	. . . .	. . . .	. . . .
9.	Bound carbonic acid (CO_2)		51.1	51.1	51.1	.	.	.	.
10.	Free carbonic acid								
11.	Lime (CaO)		82.4	82.4	82.4	70.8	.	.	.
12.	Magnesium (NgO)		11.0	11.0	11.0	8.9	.	.	.
13.	Alumina (Al_2O_3)		.	.	.	4.9	.	.	.
14.	Alkalies (Na_2K_2O)		.	.	.	33.8	.	.	.
15.	FERRIC OXIDE (Fe_2O_3)								
	Total		14.6	6.30	1.11	22.3	3.44	. . . .	. . . .
	Remaining in solution		2.08	3.38	0.46	quantitatively undeterminable traces		. . . .	. . . .
	Separated as sediment		12.52	2.92	0.65	22.3	3.44	. . . .	. . . .
16.	MANGANESE (MnO)		traces	traces	traces	2.82	2.68	1.13	. . . .
17.	Ammonia (NH_3)		traces	traces	traces	. . . .	. . . .	. . . .	. . . .
18.	Oxidizable organic substances								
	Consumption of potassium permanganate		11.06	10.11	10.11	9.7	8.9	5.9	6.2
	Consumption of oxygen		2.79	2.56	2.56	2.5	2.3	1.5	1.6
19.	Harness in German degrees								
	Total		9.78°	9.78°	9.78°	7.1°	7.1°	6.7°	7.1°
	Permanent		3.28°	3.28°	3.28°	3.9°	3.4°	3.5°	3.4°
	Vanishing		6.50°	6.50°	6.50°	3.2°	3.7°	3.2°	3.7°
20.	Reaction		acid	acid when drawn	after being transported.	alkal	alkal	alkal	alkaline
21.	Appearance		.	.	.	.	.	.	.
22.	Water gauge at Street Bridge in Glogau .... + Meter		1.24	1.24	1.24	1.13	1.13	1.13	1.13

NOTES: The figures given under No. 1—16 signify milligram per 1 liter.
" " means "not analyzed"
" . . . . " means "not demonstrable"
Mean low water: + .47 meter
Mean water: + 1.71 meter
Highest water: + 5.70 meter

IV

701 THE CUPOLA WATERWORKS OF THE CITY OF GLOGAU
(ANALYSES)

No.	Object of the investigation	Analysis:	9a	10a	10b	11a	11b	No.
		Drawn on:	2/16/09	4/1/1909		5/13/1909		
		Analyzed by	Dr. Luhrig			Dr. Sartori		
		Kind of water	Nat'l	Nat'l	Deferrized	Nat'l	Deferrized	
1.	Dissolved substances		229.6	270.4	252.0	249.2	213.6	1
2.	Loss on ignition		25.2	34.4	23.2	29.2	18.4	2
3.	Residue on ignition		204.4	236.0	228.8	220.0	195.2	3
4.	Chlorine (Cl)		11.29	12.7	11.3	10.58	11.29	4
5.	Silicic acid (SiO_2)							5
6.	Sulfuric acid (SO_3)		29.1	43.7	43.9	32.8	35.0	6
7.	Nitric acid (N_2O_5)		.	.	.	.	.	7
8.	Nitrous acid (N_2O_3)		.	.	.	.	.	8
9.	Bound carbonic acid (CO_2)		.	.	.	.	.	9
10.	Free carbonic acid		.	.	.	.	.	10
11.	Lime (CaO)		.	.	.	.	.	11
12.	Magnesium (MgO)		.	.	.	.	.	12
13.	Alumina (Al_2O_3)		.	.	.	.	.	13
14.	Alkalies (Na_2K_2O)		.	.	.	.	.	14
15.	FERRIC OXIDE (Fe_2O_3)		.	.	.	.	.	15
		Total	21.43	29.54	mirimal	21.87	quantitatively	
		Remaining in solution	quantitatively undetermin-inable traces	traces	trace	quant. undet. traces	undeterminable traces	
		Separated as sediment	21.34	29.54	. . . .	21.87		
16.	MANGANESE (MnO)		2.54	2.75	1.69	2.54	0.70	16
17.	Ammonia (NH_3)		.	.	.	.	.	17
18.	Oxidizable organic substances							18
		Consumption of potassium permanganate	6.3	6.3	5.1	7.4	6.1	
		Consumption of oxygen	1.6	1.6	1.3	1.9	1.5	19
19.	Harness in German degrees							19
		Total	6.6°	7.5°	7.8°	7.7°	7.5°	
		Permanent	3.7°	4.5°	3.8°	4.0°	3.6°	
		Vanishing	2.9°	3.1°	4.0°	3.7°	3.9°	
20.	Reaction		weak alkal.	weak alkal.	weak alkal.	neutral	neutral	20
21.	Appearance		.	.	.	.	.	21
22.	Water gauge at Street Bridge in Glogau...+Meter		2.31	4.62	4.62	3.65	3.65	22

NOTES: The figures given under No. 1—18 signify milligram per 1 liter.
"." means "not analyzed"
". . . ." means "not demonstrable"
Mean low water: + .47 meter
Mean water: + 1.71 meter
Highest water: + 5.70 meter

702 Legends on Drawings—Annex 2.

Experimental Demanganizing Plant.
Scale 1 ÷ 75

Section D-E:
Horizontal legends from top to bottom:
Deferrized water inlet 80 millimeter in diameter.
Demanganized water discharge 80 millimeter in diameter.
Flushing water discharge 80 millimeter in diameter.
Vertical Legends from top to bottom:
Ventilation.
Flushing water supply line 80 millimeter in diameter.
150 millimeter in diameter.
Flushing water discharge 80 millimeter in diameter.
Deferrized water supply line 150 millimeter in diameter.
Deferrized water supply line.
Section A-B-C:
Horizontal legends to the left of filter:
From filter.
Flushing water discharge.
Deferrized water supply line.
Flushing water supply line.
Demanganized water discharge.
Legends in wall to the left:
To the pure water well.
Discharge.
Horizontal legends to the right of filter:
.25 meter.
.25 meter—carbonate of lime.
.50 meter.
.70 meter zeolites.
.20 meter coarse gravel.
.40 meter.

703 Vertical legends from top to bottom:
Flushing water discharge 80 millimeter in diameter—deferrized water discharge.
Flushing water discharge.
Deferrized water discharge.
Flushing water supply line—Flushing water supply line 80 millimeter in diameter.
Plan View:
Horizontal legends from top to bottom:
Demanganized water discharge 80 millimeter in diameter v.

Ventilation—Deferrized water supply line 80 millimeter in diameter.
Flushing water discharge 80 millimeter in diameter.
"Ent.—Wasser" equal to Deferrized Water.
Vertical legends from top to bottom:
Flushing water supply line 150 millimeter in diameter.
Flushing water supply line.
Deferrized water supply line 150 millimeter in diameter.
Legends outside of cut:
To the pure water well.
Discharge.

VII

704 CUPOLA WATERWORKS OF GLUGAU.

Annex 3

Results:

of

THE EXPERIMENTAL DEMANGANIZING PLANT

No. of periods.	Date from	Date to	Duration of operation in hrs. min.	Filtered water quant. cubic Meter	Average quant. per hr. cubic meter	Filtering speed meter per hr.	Add. in calc perm kilo	Water quant. per 1 kilo calc. perm. cubic meter	Cost per cubic meter water Pfennige
1	10/20/08		4 –	80.0	20.0	21.0	2.0	40	
2	10/21/08		6 –	120.0	20.0	21.0	1.5	80	
3	10/22/08		9 –	180.0	20.0	21.0	1.0	180	
4	10/23/08	10/24/08	13 30	250.0	18.5	19.5	1.0	250	
5	10/27/08	10/29/08	21 30	398.0	18.5	19.5	1.4	284	
6	10/30/08	11/ 3/08	25 –	302.2	12.1	12.7	2.2	137	
7	11/ 4/08	11/ 9/08	31 . 41	555.8	17.6	18.5	3.2	174	
8	11/10/08	11/13/08	30 8	670.1	22.3	23.5	3.2	209	
9	11/14/08	11/23/08	41 30	1045.9	25.2	26.5	4.5	232	
10	11/24/08	11/30/08	47 30	1204.0	25.4	26.8	6.0	201	
11	12/ 1/08	12/ 9/08	67 . 48	1677.2	24.7	26.0	8.0	210	
12	12/16/08	1/ 2/09	102 5	2411.5	23.6	24.8	7.0	344	
13	1/ 3/09	1/14/09	101 –	2367.9	23.4	24.6	4.0	592	0.203
14	1/15/09	2/ 2/09	120 18	2571.0	21.4	22.6	4.0	642	0.187
15	2/ 3/09	2/13/09	83 11	2015.0	24.2	25.5	4.0	504	0.238
16	2/15/09	2/25/09	71 16	1690.0	23.8	25.1	4.0	423	0.284
17	2/25/09	2/27/09	22 . 05	519.3	23.5	24.8	1.0	519	0.232
18			49 30	1140.4	23.0	24.2	3.0	380	0.316
19			39 –	903.8	23.1	24.3	3.0	301	0.399
20			65 –	1471.5	22.6	23.8	3.0	490	0.245
21			53 45	1219.6	22.7	23.9	3.0	407	0.295
22			65 45	1551.4	23.6	24.8	3.0	517	0.232

705 DEF. EX. 62.

THE PERMUTIT COMPANY
440 Fourth Ave.
New York

March 18th, 1920.

Dr. Chas. F. McKenna,
50 Church Street,
New York, N. Y.

Dear Doctor McKenna:—

When talking with you over the phone a few days since, I promised to send you some of the literature of this Company so that you might be acquainted with what we do.

We really are what you would call "Water Doctors", and if anyone having any trouble with their water will kindly send us a sample and particulars of the trouble they have, we will undertake to cure it by some method or another, mostly the "Permutit" Process but we do not confine ourselves to that. We always hold ourselves open to any process which might meet the particular case in hand, as there are cases, though very few, in which the "Permutit" process may not be suitable. When we have a case of this kind we do not hesitate to suggest other kinds of processes, but we have yet to find one which can not be treated by the "Permutit" process. There might be commercial reasons why it would not go in but they are few and far between.

The process is a very simple one as you will notice by the literature which we enclose. It is nothing more or less than a filter but the bed, instead of being sand or some other material, is a zeolite which is manufactured in our factory in Brooklyn. Through this water passes, and in passing the mineral constituents Calcium and Magnesium are exchanged for the corresponding Sodium salts so that all hardening materials are taken from the water, leaving a water of absolutely zero hardness which, as you know, is impossible to be obtained by any of the older processes in existence—not even hot lime sado will do it although that is not a bad process. The apparatus is simpler than any other and requires less attention, being practically foolproof.

Should you at any time come across any clients looking for a process which will take up less room than the larger

methods require, we shall always be pleased to discuss
706 matters with you and either work through you as the consulting man or take up the matter directly with any client you may introduce to us.

We have now several thousand plants in operation, varying from 500 gallons per day water treated to as many as 3,000,000 gallons per day, without considering Government plants and the like. You will notice in a Government bulletin which we are sending you that the process is on record as being worth consideration and we have several other interesting pamphlets which you will no doubt cast your syes over and give us the benefit of your wide connection should occasion arise.

Thanking you for your kind consideration, we are

Yours very truly,

THE PERMUTIT COMPANY

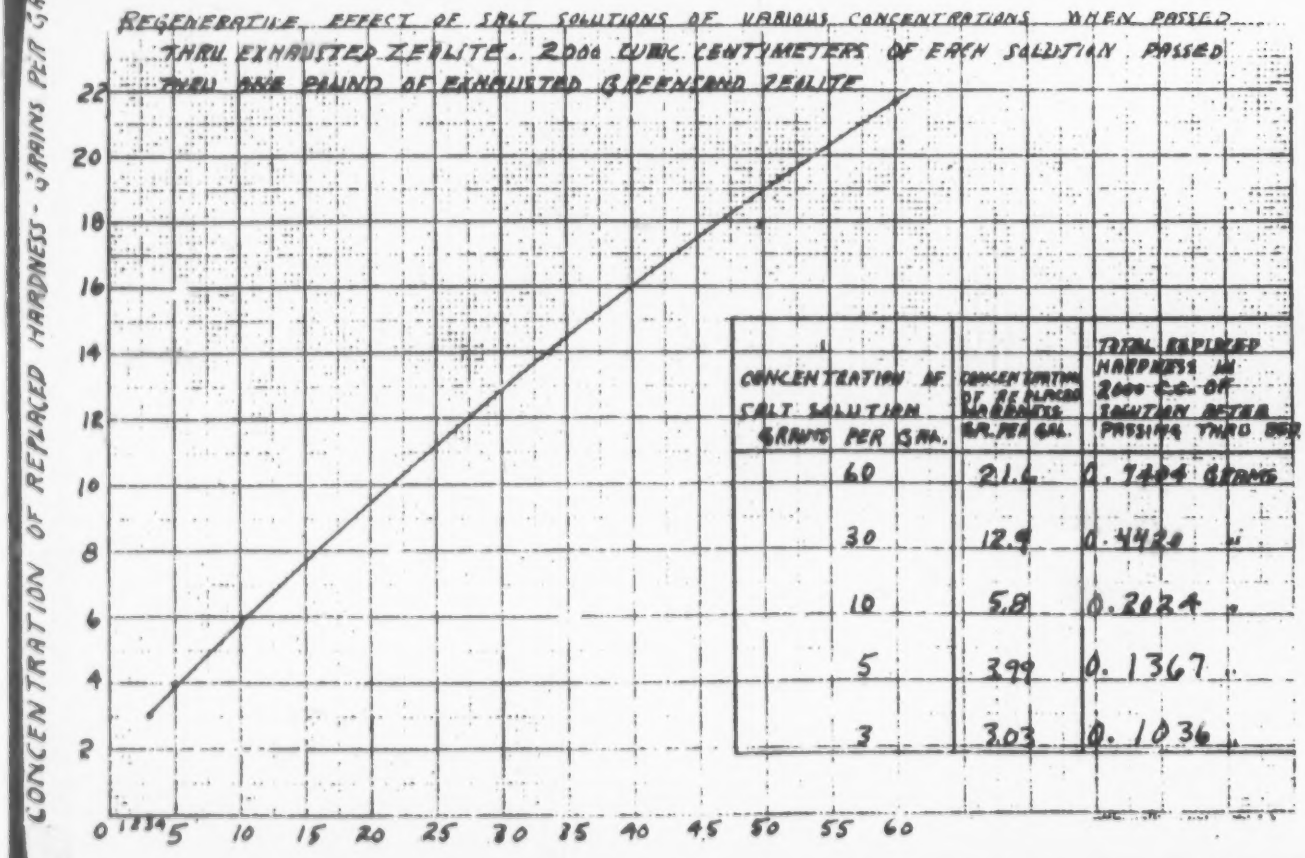
THOS. R. DUGGAN,

Technical Manager.

TRD:MK
Enclosures

DEFENDANT'S EXHIBIT 64

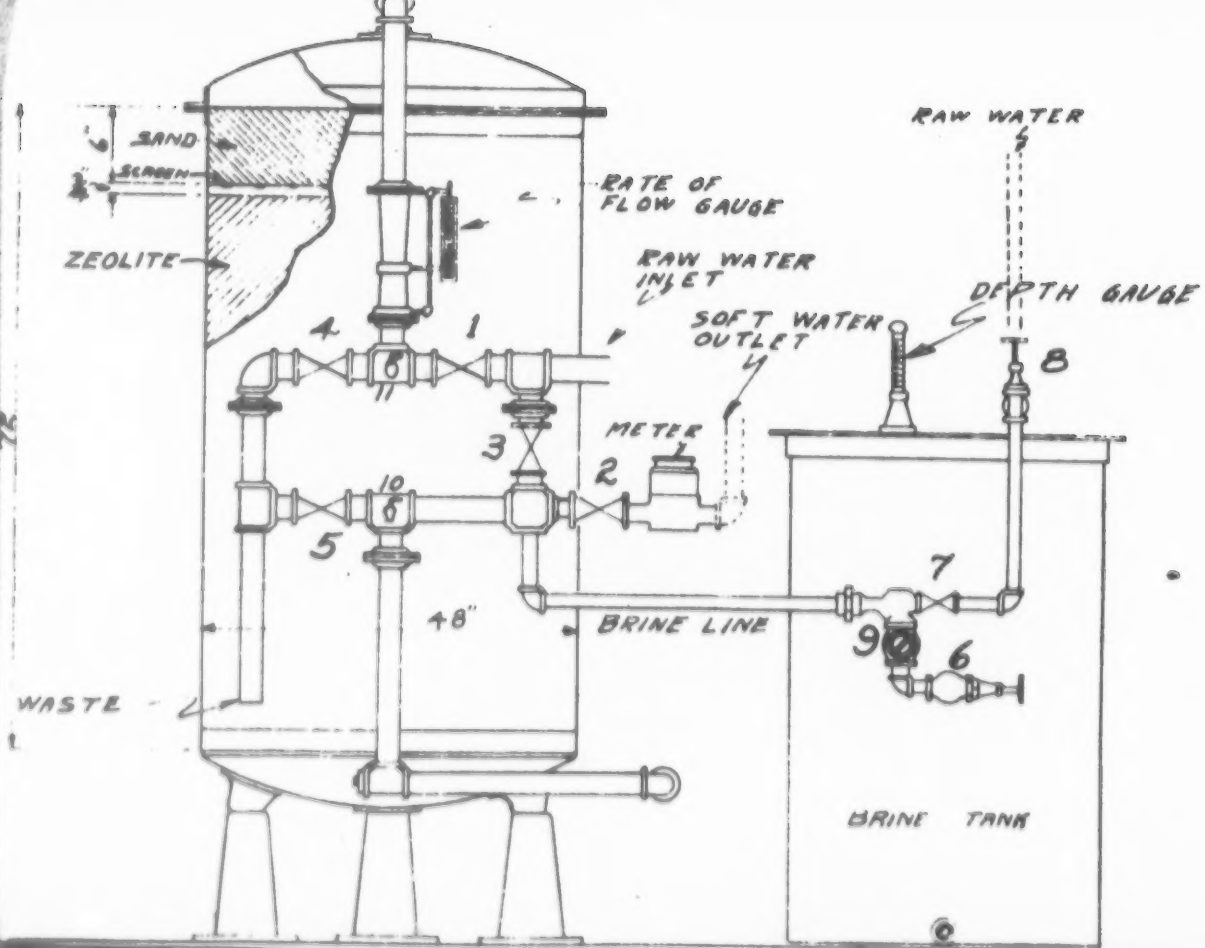
REGENERATIVE EFFECT OF SALT SOLUTIONS OF VARIOUS CONCENTRATIONS WHEN PASSED THRU EXHAUSTED ZEOLITE. 2000 CUBIC CENTIMETERS OF EACH SOLUTION PASSED THRU ONE POUND OF EXHAUSTED GREENSAND ZEOLITE


CONCENTRATION OF REPLACED HARDNESS - GRAINS PER GAL.
0 1 2 3 4 5 10 15 20 25 30 35 40 45 50 55 60
2 4 6 8 10 12 14 16 18 20 22
CONCENTRATION OF SODIUM CHLORIDE IN REGENERATING SOLUTION - GRAINS PER GALLON

CONCENTRATION OF SALT SOLUTION GRAINS PER GAL.	CONCENTRATION OF REPLACED HARDNESS GR. PER GAL.	TOTAL REPLACED HARDNESS IN 2000 C.C. OF SOLUTION AFTER PASSING THRU ZEO.
60	21.4	0.7494 GRAINS
30	12.9	0.4420 "
10	5.8	0.2024 "
5	3.99	0.1367 "
3	3.03	0.1036 "

DEFENDANT'S EXHIBIT 65.

708-801 (Gans File-wrapper and Contents omitted per stipulation filed June 10, 1930. See index.)


SAND
SCREEN
ZEOLITE
RATE OF FLOW GAUGE
RAW WATER INLET
SOFT WATER OUTLET
RAW WATER
DEPTH GAUGE
METER
BRINE LINE
48"
WASTE
BRINE TANK
72"
1
2
3
4
5
6
7
8
9
10

803 And on to-wit: the 20th day of January, A. D. 1930, there was filed in the Clerk's office of said court a certain Memorandum in words and figures following, to-wit: Filed Jan. 2 1930.

804 * * (Caption) * *

MEMORANDUM OF THE COURT.

Walter C. Lindley, District Judge.

Plaintiff seeks to enjoin defendant from manufacturing water softeners said to infringe claims 1 and 5 of patent to Robert Gans of Berlin, Germany (J. D. Riedel Aktiengelsellschaft, of Berlin, Germany, assignee) applied for August 5th, 1911, issued August 22, 1916, No. 1,195,923, as follows:

Claim 1. A water softening apparatus comprising a casing, a filter bed consisting of a layer of sand or quartz and a layer of zeolites or hydrated alumino-silicates disposed on the layer of sand or quartz, means for permitting the passage of water through the casing, means for cutting off supply of water on the exhaustion of zeolites, and means for passing through the casing a solution of a salt capable of regenerating the zeolites.

Claim 5. Water softening apparatus comprising a casing, a filter bed consisting of a layer of zeolites or alumino-silicates, supporting means for said layer, means for permitting the passage of water through the casing, means for cutting off the supply of water on the exhaustion of the zeolites, means for supplying and passing into the casing a solution of a salt capable of regenerating zeolites and means connected to the lowest point of the casing for removing the salt solution so introduced.

Defendant asserts as defense invalidity and non-infringement.

As originally granted the only substantial difference between the two claims was the addition to claim 5 of the last element, viz., "means connected to the lowest point of the casing for removing the salt solution so introduced."

Pending a similar suit in Detroit, Plaintiff, on March 2, 1920, disclaimed from the scope of claim 1 any such apparatus as is therein described in which the water to be softened passes upwardly through the zeolites, thereby limiting claim 1 to the down-flow type. Claim 5 is not so expressly limited,

and despite defendant's contention that said disclaimer should effectualy likewise limit it, other courts have refused so to hold. (*Permutit* v. *Harvey Co., et al.,* 290 Fed. 713, and *Permutit Co.* v. *Wadham, et al.,* 13 Fed. (2) 454.)

The subject matter is an apparatus for softening water by means of zeolites, which are chemical compounds existing in nature, but likewise produced chemically and so produced patented by Gans in Patent No. 960,887. The possess the unique and valuable property of being able, when saturated with a solution of sodium chloride, to take up from water passed through them such hardening elements as calcium or magnesium and, when once thoroughly charged with the latter, to exchange the same for salt when brought in contact therewith. The nature and properties of zeolites are alluring, but they are the subject matter not of this but of prior patents.

The claims here under consideration do not cover the idea of softening water by means of zeolites, the regenera-
805 tion of said zeolites, or the rinsing thereof by backwashing. They cover only a filtering device for making use of zeolites in such manner as to utilize their known functions in softening water.

The essential elements of water softening are the passage of water through zeolites, the regeneration of such zeolites when exhausted by recharging them with a sodium chloride solution and the rinsing thereof, so that no noticeable tinge of salt remains in the water when reduced to practical use.

When Gans made his application in 1911 all claims were rejected on three Bommarius patents Nos. 519,565, 632,091 and 707,899 as merely involving the substitution, for the filtering material of Bommarius, of the material disclosed in Gans patent No. 960,887, where Gans had explained the properties of zeolites and demonstrated that water may be softened thereby and the exhausted silicates regenerated by a solution of common salt. Gans next urged that a chemical action took place in his process, as contrasted with the mechanical processes of Bommarius. Again the claims were rejected as reciting nothing more than the substitution of a water treating means disclosed in patent applications of record for the water treating means disclosed by the three references. On August 26, 1914 Gans canceled certain claims and asked that claims 4 to 7 stand. Said claim 4 is now claim 1 of the patent, with the limitation "of a layer of sand or quartz."

Claim 5 in its present form was introduced into the appli-

cation on March 26, 1915. It was rejected as disclosing nothing more than a double use of the apparatus disclosed by each of the patents to Bommarius. On June 30, 1915 Gans amended and again the claim was rejected. On April 21, 1916 another amendment was made, and on May 6, 1916 claim 5 was finally rejected. Then on June 16, 1916 claim 5 was amended by adding these words: "and means connected to the lowest point of the casing for removing the salt solution so introduced." The patent office found no basis for patentability until this last mentioned element was added.

The patent office did not mention any of the references hereinafter discussed, all of which are German in their origin. In view of their direct relevancy and pertinency to the questions then before the Commissioner, the only fair inference is that the office had no knowledge thereof.

In addition to the Bommarius patents mentioned by the patent office, covering three forms of apparatus for water filters, consisting of a casing with layers of filtering materials through which the water was passed, as indicative of the state of the art, defendant has submitted to the court the Feldhoff Article of September 7, 1907; the Technische Rundschau Article of January 27, 1909; the Gans Article of April 15, 1909, all German publications; the German Leister patent No. 211,064; German Gebrauchsmuster No. 341,512; German Gebrauchsmuster No. 313,671, and certain other patents and a thesis published in German, known as the Weiss Thesis.

The expressed elements of claim 1 are an apparatus comprising: 1. a container (casing); 2. a filter bed of sand; 3. a layer of zeolites on the sand; 4. means for permitting the passage of water through the container; 5. means for cutting off the water; 6. means for passing through the casing a solution of salt to regenerate the zeolites. The elements of claim 5 are the same, with the addition of the means for removal of salt solution to be connected with the lowest point of the container.

Under the Bommarius patents a container with filter bed of sand and means for permitting the passage of water there through were old. Nor was there anything new in the substitution of zeolites for the filtering material of Bommarius.

The claim of invention finds basis eventually in the asserted inclusion in each of the claims of an element, not expressed therein but claimed by plaintiff, and recognized in the 806 cases cited, to be necessarily implied, viz., a requirement that the bed of zeolites mentioned shall be open, i. e., that

there shall be an open space between the top of the zeolites and anything above them, thus furnishing opportunity to the silicates to spread out when flooded, and the inclusion in Claim 5 of the element that the means for draining the salt solution from the casing shall be connected thereto at the lowest point. If the claims do not necessarily imply a free or open bed of zeolites as contrasted with "a locked bed," or, if the inclusion of such implied element in the combination did not bring about invention claim 1 fails, and if in addition the element of attachment of the drain for salt water at the lowest point was not invention, claim 5 fails.

The Gans article was published on April 5, 1909 under the heading "The Technique of Water Purification." He therein stated: "The process is in its most simple form a pure exchange process by which the calcium and magnesium of the water are taken up by the zeolite and the sodium is given off to the water. * * * The regeneration is performed by washing off the zeolites, which have been saturated with calcium or magnesium, with a common salt solution, by which means a sodium zeolite is again produced which is again able to soften new quantities of water. * * * There are already several filters of this sort in use, some to prepare soft water for boiler feed purposes and other for laundries. The filter plants are remarkable through the simplicity of their arrangement. * * * The softening is complete with cold water. * * * The apparatus consists of an iron or wooden filter. The height of the permutit (zeolite) bed is determined by the hardness of the specific water and the rapidity of filtration. The useful effect is greater the more slowly the water flows through the permutit filter and the finer the grain thereof. The permutit bed lies upon fine sand, which becomes coarser at the bottom." The proper translation of the next sentence is in dispute. Defendant's translators read it as follows: "At the top it is best closed off by a sand filter placed about one-third to one-half meter above the surface of the permutit layer." The remainder of the paragraph is not in dispute, and is as follows: "The sand filter under many conditions can be replaced by a limestone filter, for instance, when treating water containing iron and acids: This arrangement of the upper sand or limestone filter will also prevent that by back-washings, the specifically lighter permutits are not mechanically washed away."

If the defendant's translation be accepted it would appear that Gans in 1909, more than two years before the filing of

his patent, published to the world a description of a water softener containing every claimed essential element of Claim 1. Plaintiff insists that the proper translation of the disputed sentence above mentioned is in substance as follows: "At the top it is best finished off by a sand filter which, with a thickness of about one-third to one-half meter is arranged over the surface of a permutit layer," and contends that this language indicates that when Gans wrote the article in 1909 he was not describing the apparatus which he later patented, but one in which there was not a free space above the body of zeolites.

Appreciating that the proper translation is a question of fact, I am of the opinion, after a careful perusal of all of the direct and cross-examination of the translators that defendant's translation is more nearly consistent with the original meaning of the German words used than that of the plaintiff. The cross-examination of the translators who testified for plaintiff weakens the force of their direct testimony. I am of the opinion that at that time, in 1909, Gans was describing a body of zeolites which was free and unconfined.

In this connection the testimony of the president of the plaintiff brings to light some interesting facts. He was an associate of Gans in Germany and observed certain apparatus for softening water in which there was directly above the
807 body of zeolites not an entirely open space, but one occupied by excelsior held in contact, according to his testimony, with the zeolites by a floating weight. He testified as to the results of his observation and said that subsequent to said time Gans showed to him and tested in his presence a different arrangement in which the excelsior was omitted and replaced by a free space above the zeolites; that this excelsior was removed from the second apparatus and the free space substituted therefor in the latter part of 1907 or the early part of 1908; that at that time Gans discarded the excelsior and designed his device with an open space above the zeolites; that about the middle of 1909 the witness built filters according to Gans' later design, and that thereafter he built only devices with free spaces above the zeolites. Thus the plaintiff has furnished testimony to the effect that in the latter part of 1907 or the early part of 1908 Gans became convinced by the demonstrated operation of the device that the excelsior should be removed and a free space substituted therefor and then eliminated the excelsior and supplanted the same with a free space. With this realization in his mind, the ex-

istence of which is proved by plaintiff, it is unreasonable to believe that he would, a year after he made his alleged discovery of the necessity of free space, describe in his published article as a satisfactory filter one which did not have the free space, the alleged deficiency of which plaintiff now proves Gans discovered as early as the latter part of 1907 or the early part of 1908. Gans, the only witness who could have thrown more light upon this subject, residing in Germany, was not brought to this country as a witness, nor was his deposition taken. There is certainly no presumption that if produced by the plaintiffs he would have testified to anything in contradiction to his former associate, or that he did not intend to describe an unconfined bed of zeolites in his publication. The conclusion is unavoidable that Gans in April 1909 intended to describe and did describe a filter with the essential elements of his later application and one containing the now alleged implied essential element of a free and unconfined space above the zeolites. He disclosed a water softener apparatus composed of a casing, a filter bed of sand, a layer of zeolites disposed thereon, means for permitting the passage of water through the casing, means of cutting off the supply of water on the exhaustion of zeolites, the suggestion of regeneration to be accomplished by washing off the zeolites with a salt solution and of backwashing for rinsing.

Gans said that the arrangement he suggested would prevent the light zeolites from being washed away by "backwashings." This was information to the public that backwashing for the purpose of washing off the salt solution was essential; that he did not further discuss it undoubtedly was due to the fact that such treatment is obviously necessary in order to rid the zeolites and the filter casing of an excess of salt before the water becomes palatable.

This is of importance. Plaintiff now insists that claim 1 comprises as one essential element a free and unconfined bed of zeolites, and supports the assertion by the testimony of its expert, who after admitting that in neither the claims nor description of Gans' patent is there any statement about a free and unconfined zeolite bed, said that Gans must have contemplated a free and open bed because in the description he speaks of "backwashing," and that the conclusion that it is essential that the bed of zeolites be free is implied from Gans' use of the word "backwashing," for the reason, as the witness claims, that there cannot be proper backwashing of a locked bed. In his article Gans uses the word backwashing

obviously with the same meaning, and if it is necessarily a conclusion that the word "backwashing" in the patent presupposes a free bed of zeolites, then it is equally true that the use of the word backwashing in the article presupposes the same kind of a bed. Thus, on the theory of plaintiff's 808 expert, it is evident that Gans in 1909 was describing a filter with a free bed of zeolites, thus corroborating the testimony of plaintiff, that as early as the latter part of 1907, or the early part of 1908 Gans had realized that excelsior would not do, and was building before 1909 an apparatus which had a free bed.

On September 7, 1907 there was published in a technical journal in German a lecture delivered by one Feldhoff, evidently a pupil of Gans, in which Feldhoff described to engineers the nature and properties of zeolites. He directed attention to everything Gans had then published, advised his hearers of the chemical formulae and performed demonstrations of the process before them. He remarked: "It would be 'carrying owls to Athens' for me to waste many words for this assemblage of recognized skilled engineers upon the value of a rational method of de-liming boiler feed water." He produced a small filter and said that the water was led into the same from below, passed through a layer of gravel, proceeded upward through the zeolites and left the filter fully softened; that when the filter was exhausted one should pass a solution of sodium chloride through the zeolites, following the same path as the water by turning a two-way valve and that the excess salt should be removed by washing. He stated that Riedel had erected such a filter which had been commercially successful and produced a full set of drawings which disclosed a casing containing a filter bed of sand, a layer of zeolites thereon, means for permitting the passage of water through the casing and a valve for cutting off the supply of water and means for passing through the casing a solution of salt capable of regenerating the zeolites.

This was an up-ward flow softener, through an unconfined body of zeolites, and, apparently appreciating the significance of the disclosure plaintiff, after instituting its suit in Detroit in 1920 filed its disclaimer as to claim 1, disclaiming as to up-flow softeners. Later the Court of Appeals in *Permutit* v. *Wadham*, 13 Fed. (2) 454, in holding that claim 1 was valid said: "Nor does it follow that * * * there is no patentable distinction between the downflow and the upflow. The former works satisfactorily, and it seems probable, if not

certain, that the latter would not. The reason why one will and the other will not shows that this difference is one of those which are not so simple as they seem." Obviously the Court was of the opinion, drawn from the evidence before it, that the upward flow softener would not work and that, therefore, the reference to an upward flow softener was not pertinent. The evidence in the instant case is conclusive to the effect that upward flow softeners are in fact of greater utility and efficiency than downward flow softeners.

Plaintiff's own Duggan patent No. 1,276,629, originally asserted in the cited case in the district court as one basis for relief, but afterwards withdrawn, is a complete rebuttal of the claimed advantages of the downward flow type softener, for after discussing the difficulties in a downflow device the patentee said: "an upward passage of water in the softening phase avoids in large measure these difficulties, giving a greater period of activity since the buoying action of the current keeps the granules apart and prevents packing and channeling." Duggan pointed out the advantages of his alleged invention, including a locked zeolite bed, where the zeolites are kept in position by a cross plate resting thereon. When plaintiff filed its said suit, relying upon both Duggan and Gans, it was relying under Duggan upon his assertion of the desirability of the upward flow locked bed type softener, and under Gans, as finally interpreted, upon the theory that neither the lock type nor upward flow was feasible. By dismissing as to Duggan, and by disclaiming under claim 1 as to upward flow types, plaintiff was in a position to attack the efficiency of upflow softeners with locked beds, and insist, therefore, that the Feldhoff article taught Gans nothing he making of his apparatus.

809 Gebranchsmuster No. 313,671 was registered June 27, 1907, according to the German law under the title, which was published to the world: "Filter for Removing the Lime from Boiler Feed Water consisting of a box with permutit (zeolith) filler enclosed between layers of gravel, a regenerating Device." In his application the applicant stated that the subject matter was a filter for removing lime from boiler feed water; that it consisted in part of a container funnel-shaped at the lower part, and containing a layer of gravel of thirty centimeters thickness, zeolites of 750 liters, and on the top of the latter another layer of gravel of 20 centimeters thickness; that it included means for introducing water into the container, distributing the same by a baffle

plate, passing it through the gravel and zeolites and causing it to emerge free of limt or magnesium. To regenerate, applicant provided a two-way valve so that a solution of salt could be passed through the filter and out of the same through a discharge pipe. A man hole was provided in order to clean or remove the gravel. Apparently each of the elements named in claim 1 are presented in this description, with the exception of the alleged implied essential that the bed of zeolites shall be unconfined.

Gebrauchsmuster 341,512, May 30, 1908, by Neumann, claimed a soft water filter for domestic purposes comprising different elements, consisting of a tank in which had been placed zeolites, and a sprinkler entering below the level of the hard water, distributing the water into the filter. The water flowed through the entering pipe, passed through the zeolites and ran off in a softened state at the bottom. The top of the casing and the bed of zeolites were open, and the zeolites were regenerated by being flushed with a common salt solution. The drain pipe was at the lowest point of the casing. Backwashing could be accomplished by connecting a water supply to the outlet at the bottom of the tank.

It is asserted that these Gebrauchsmuster files are not patents and therefore not pertinent references. In this country various classes of inventions may be the subject of patent, viz., arts, machines, manufacturers or processes, compositions of matter and designs. We have one class of patent protection for all inventions. Patent protection is an exclusive right given to inventors for limited time in and to their respective disclosures. On Langner testified that as an international patent and trade mark solicitor he is thoroughly familiar with the German law and furnished a translation of the same. His testimony is that in Germany the standards as regards patentable invention is higher than elsewhere, with the result that it is difficult to secure a patent. Consequently, in past experience, minor or simpler inventions could not be protected under the patent law. To remedy such situation, the Gebrauchsmuster Law was adopted, as supplementary legislation, to protect useful models which did not have as high a standard of invention as required by the patent laws. These laws, however, grant monopoly for such invention as is registered, limited to a term of three years, subject to be renewed for an equivalent period. The law provides that the owner of the device shall have the exclusive right to make, use and sell the same and to recover damages for infringe-

ment of his rights. Solicitors in Germany file petitions for allowance of patents in the alternative, so that if a patent be denied a Gebrauchsmuster may be allowed. The applicant files a comprehensive title, and, if registry is granted, that title is published in the official Gazette. The application contains specifications and drawings and the claim and description are registered and are open to examination at the patent office. True it is there is no examination for novelty, but the same is true as to patents in many countries. In such situations the question of novelty first arises when a suit is brought.

I have examined the German laws as to patents and Gebrauchsmuster, and it is apparent that the same monopoly is granted under the Gebrauchsmuster law as under the 810 Patent law, but that it is more limited in time. The German laws provide for registry of designs under the Geschmackmuster law, for useful models under the Gebrauchsmuster law and for other inventions under the Patent law. Evidently a Gebrauchsmuster is a patent within the meaning of the federal statute, as Judge Haight said in the case of *Safety Gas Lighter Co.* v. *Fischer Bros. & Corwin*, 236 Fed. 955: "The rights conferred on an inventor by a German Gebrauchsmuster, except as to time, seem to be quite as extensive as those guaranteed by a patent in this country. Its grant is the act of the government. Although only the title is published, in the sense that it is printed in an official publication, the specifications and drawings of the patent are open and accessible to the public, as are also the claims, which measure the scope of the protection afforded to the inventor, as soon as the title, date of application, and registration are published in the Patentblatt. As it is not essential that a foreign patent, to have the effect mentioned in section 4886 of the Revised Statutes, should be printed, but that the act of the officials in granting it and accessibility of its disclosures to the public are the decisive factors, I am at a loss to understand how the fact that only a title is printed, or how the scope of the invention which it protects, or that the examination made in the Patent Office before it is granted is limited, can have any effect on it under our laws."

Leister German Patent No. 211,064 granted January 23, 1908, disclosed an apparatus comprising a container, one or more gravel beds and a bed of zeolite. The water passed into the container downwardly through the sand into the zeolites, then outwardly from the bottom into the water service line.

To regenerate, a salt solution was supplied through the pipe passed upwardly through the zeolite bed, out into the waste pipe. After regeneration the zeolites and gravel are rinsed. There is some contention that Leister had no unconfined bed. He expressly states, however, that the beds are separated from each other by spaces, and the drawings indicate free spaces above both the gravel and the zeolite beds.

Defendant presents a thesis by one Weiss published June 3, 1910, less than two years prior to the filing date of the Gans patent, but earlier than any date established by plaintiff of its introduction of its alleged invention into this country. This thesis discloses a casing, near the lower end of which there is a mechanical filter 0.20 of a meter high, a bed of zeolites 0.70 of a meter high, and then at a distance of 0.50 of a meter above the zeolite bed another mechanical filter 0.25 of a meter high; and in addition a stirring device similar to that shown in the Gans patent. This reference discloses a free space above the zeolite bed. The apparatus was tested out at the City Water Works in the City of Glogau, Germany, in 1908 and thereafter in January and February of 1909. From the evidence submitted it seems that Gans, in his article of 1909, was discussing this Glogau installation.

January 27, 1909, there was published in the Technische Rundschau, an article which discloses a softening device contained in a cylindrical casing with a conical bottom. Above the cone-shaped bottom, on a perforated plate was coarse gravel, on this fine gravel and on top of this, zeolites, covered with a loose, uniform layer of excelsior, held down by a perforated cover, over which a canvas was stretched. Water passed into the casing at its lowest point, rose upward through the gravel, zeolite and excelsior to the distributing pipes, emerging soft. The article discloses that the exhausted zeolites were regenerated by a salt solution supplied through a pipe controlled by a valve, passing downwardly through the zeolites. The salt solution apparently passed out through the pipe attached at the lowest point of the casing. The filter was washed out with water passed upward through the filter. Plaintiff raises a question as to whether the draining of the salt solution is from the lowest point of the casing.

Defendant built a softener in accordance with its understanding of this article and operated the same at the
811 Hawthorne Laundry. Plaintiff's experts admitted that the operation was successful, the only dispute being as to whether or not in the structure made by defendant, the bed of

excelsior was located and confined in the same manner as indicated in the Rundschau article. After considering all of the evidence the court is of the opinion that the construction in question was in substantial accordance with the disclosure of the Rundschau article.

I have discussed the prior art references at some length because these claims have been held valid by the Courts of Appeals for the Second and Sixth Circuits in the cases herein first cited. Those courts, at one time or another, had before them all of the references mentioned herein, except the Weiss Thesis. Having the greatest respect for those courts, I have taken great care in my examination of the prior art and of the evidence here presented in order to determine whether my convictions in the contrary direction are proper. To me it seems manifest that had this situation been as fully presented to the various courts before whom there has heretofore been litigation as here, there could have been but one conclusion. As stated by the Supreme Court in *Mast et al.* v. *Stover Mfg. Co.*, 177 U. S. 485 at 488: "Comity persuades, but it does not command. It declares not how a case shall be decided, but how it may with propriety be decided. It recognizes the fact that the primary duty of every court is to dispose of cases according to the law and the facts; in a word, to decide them right. In doing so, the judge is bound to determine them according to his own convictions. If he be clear in these convictions, he should follow them. It is only in cases where, in his own mind, there may be a doubt as to the soundness of his views that comity comes in play and suggests a uniformity of ruling to avoid confusion, until a higher court has settled the law. It demands of no one that he shall abdictate ehis individual judgment, but only that deference shall be paid to the judgments of other co-ordinate tribunals. Clearly it applies only to questions which have been actually decided, and which arose under the same facts."

Defendant contends that the prior art references from Germany are not sufficiently clear to prove anticipation, and in view of the uncertainty of certain translations it may be that the teachings are not of sufficient degree of certainty to satisfy the requirements stated by the Supreme Court as necessary to support anticipation. But Gans was bound by the teachings of the prior art, and the question arises whether, with those teachings in mind, he exercised merely the mechanical skill of one learned in his profession, or achieved invention.

The reasons ordinarily urged against foreign teachings do not find the usual basis here, for the applicant resided in Germany; the publications were published there, some by himself, some by his associates, some by scientists like himself. It was in America that he applied for a patent, upon claims never submitted to his own government, to a patent office obviously without notice of these German publications. He assigned his application, and eventually it came to the plaintiff, some of the officers of which were associated with him in Germany. Yet we do not have his story of his experiences.

What had the art taught Gans when he filed his application? His own patents on zeolites and his article of April 15, 1909 demonstrate that he had learned how to make zeolites, what their properties were, and how to make a softening apparatus. He had the benefit of Feldhoff's teaching of 1907, of the Technische Rundschau article in January 1909 and of the Weiss Thesis early in 1910. He knew what Leister had patented; he knew the titles of the two German Gebrauchsmuster, registered and published to the world. He knew everything reasonably to be drawn from the prior art as hereinbefore set forth, and that, it seems apparent to the court, furnished everything that any one skilled in the art would need in order to perfect the apparatus produced. Neither the idea of the container nor that of a bed of zeolites was new.

Others had produced a softening apparatus with a layer 812 of sand and on top of it a layer of zeolites. There were many filtering devices containing means for the passage of water through the casing; for cutting off the supply of the water and for passing through the casing regenerating solution. Indeed plaintiff's asserted patentability of the claims is ultimately confined to the element that the unconfined bed of zeolites in a downward flowing softener shall be free and unconfined, and upon claim 5 to the same in upward flowing types also and the additional element of attaching the drain for the salt solution at the lowest point of the casing. Only these elements are left to save plaintiff's claim of invention.

To say the claims include as an essential requirement that the bed shall be unconfined is to read into the claim something that is not stated in specifications, description or claim, but which defendant insists must be implied because of the so-called stirring apparatus, which is never used, and the statement as to backwashing. Obviously neither implication is necessary or logical. Backwashing, under the evidence, may

be accomplished whether there be an unconfined bed or not, though it may not be so efficient in a confined bed. Furthermore, the stirring apparatus can be used in a confined bed, it being necessary therewith simply to run the pinion upon which the stirring apparatus turns, through the cover confining the zeolites, and attach thereto, below the cover, the stirring blades.

I am of the opinion that there is no warrant for reading into claim 1 any requirement that the bed of zeolites shall be free, but, as stated, if that element is necessarily implied, it likewise is imported in the prior art, as shown by Gans' own publication, for, if backwashing in the patent implies a free bed, so backwashing in his early article, dealing with the same subject matter, must import the same conclusion.

Furthermore, the testimony of the plaintiff's president and the language of the prior publications is such that Gans was bound to know and did know as early as the latter part of 1907 or the early part of 1908 that some of the people skilled in the art believed that the body of zeolites should be free and unconfined, and that he himself made a device with such a bed more than two years prior to the filing of his application. In other words, the state of the art in 1909 was such that he and his associates believed that in an apparatus, such as any of them described, a free and unconfined bed of zeolites would prove the more practicable.

Then too, I am not willing to say, even if some may believe that the idea of a free bed of zeolites were not in the prior art, that the addition of the same to the combination amounted to invention. Gans knew the properties of zeolites; he knew that in order to function they must be charged with salt and when exhausted, recharged; that mechanical filters were desirable to eliminate the physical impurities of water, and that after regeneration the container and its contents should be rinsed of excess salt. He knew that the nature of any material like zeolites or sand is such that in order that they may be thoroughly cleansed the granules should, as nearly as possible, be in suspension, exposing all their sides of the liquid in which they are bathed. He knew that if he wanted to wash sand he could best do so when it is an uncompacted or suspended mass, and that the same was true of zeolites. It was therefore obviously necessary that to get complete submersion he must lease the upper part of the zeolites to a certain extent at least unconfined. He knew further that in order to secure lack of compactness or suspension, there must be some

free space above the body of zeolites furnishing room for expansion when flooded with water. I do not believe that even though we read into these claims an unexpressed intention on the part of Gans that the body of zeolites should be open, and even though the idea of a free space was not old, the result amounted to anything more than the natural and obvious method of meeting the problem by one skilled in the art.

813 As to claim 5 we have even a more weak assertion as to one element,—means for removing the salt connected to the lowest point of the container. It was the addition of that element only that procured the allowance of the claim. Was this invention? Suppose we have before us an apparatus as claimed in claim 5 without this last element? What is the easy, natural and obvious manner in which to drain the salt solution, which, following the course of gravitation goes to the bottom of the casing? A school boy would reply that the obvious manner is to put a plug and tap at the lowest point.

A multiplicity of elements may be added indefinitely without creating a patentable combination, unless by their collocation a new result is produced. The adding of a plug and connecting the same to a waste pipe, in order to drain off the solution of salt from Gans' container was merely solving the problem of a plumber.

I am of the opinion further that the patent office was right in its conclusion that in substance the claims are merely reproductions of structures found in the prior art; that in such filters as those in Jewel No. 478,261, July 5th, 1892, Bachman No. 678,532, July 16, 1901 and Driesbach No. 630,870, we find apparently a free and unconfined bed, the elements injected into these claims by the Court of Appeals for the Sixth and Second Circuits in order to validate the same. Remembering the comments of the patent office upon the Bommarius patents, observing that the defendant at the present time manufactures sand filters of the same structure as zeolite softeners, it seems claim that there was no invention in either claim because of the substitution of zeolites. Duggen, technical manager of the plaintiff, in March 1920 wrote a letter, in which he said: "The process is a very simple one as you will notice by the literature which we enclose. It is nothing more or less than a filter, but the bed, instead of being sand or some other material, is a zeolite which is manufactured in our factory in Brooklyn."

True it is that the process of softening involves a chemical change as the water passes through the zeloites, where as the

purification of water through sand involves only the removal of physical impurities, yet the mere substitution of the zeolites for sand is not invention, in view of the fact that zeolites themselves were previously patented by Gans. (No. 943,535, reissues thereof No. 13,688, and No. 960,887.) He undoubtedly accomplished invention in these patents, but when he merely adapted the sand filter construction to the use of zeolites by substituting the latter for sand he did not accomplish invention. The art of filtering and that of softening, if not identical, are surely analogous. (*Jay* v. *Weinberg, et al.*, 262 Fed. 973,—C. C. A. 7.)

From what has been said it is apparent that there should be a decree dissolving the temporary injunction heretofore entered, declaring claims 1 and 5 invalid for want of invention, and dismissing the bill for want of equity at the cost of plaintiff.

(Endorsed) Filed Jan. 20, 1930. Charles M. Bates, Clerk.

Decree entered Jan. 24, 1930.

814 And afterwards, to wit, on the 24th day of January, A. D. 1930, being one of the days of the regular December term of said Court, in the record of proceedings thereof, in said entitled cause, before the Honorable Walter C. Lindly District Judge, appears the following entry, to wit:

815 * * (Caption) * *

DECREE.

Friday, January 24th, 1930.

Present: Honorable Walter C. Lindley, District Judge.

This cause came on to be heard at this term, and was argued by counsel, and thereupon, upon consideration thereof, it was

Ordered, Adjudged and Decreed, as follows, to-wit:

1. That Claims 1 and 5 of the Gans patent No. 1,195,923 granted August 22, 1916, are invalid for want of invention;

2. That the Bill of Complaint is dismissed for want of equity;

3. That the temporary injunction heretofore entered be and the same is hereby dissolved; and

4. That the defendant recover its costs, to be taxed by the Clerk of this court.

WALTER C. LINDLEY,
United States District Judge.

Approved as to Form:
WILKINSON, HUXLEY, BYRON & KNIGHT,
Counsel for Defendant.
CHARLES A. CHRITTON,
Counsel for Plaintiff.

Chicago, Illinois,
January 24, 1930.

816 And on to-wit: the 20th day of May, A. D. 1930, there was entered in said court the following Order, to-wit: Order ente May 20, 1

817 * * (Caption) * *

Tuesday, May 20, 1930.

Present: Honorable Walter C. Lindley, District Judge.

ORDER.

On motion of attorneys for plaintiff, and by stipulation of counsel for the respective parties,

It Is Ordered by the court that the time for the plaintiff to file its record for appeal in the above entitled case be and the same is hereby extended thirty days from this date.

Dated at Chicago, Illinois, May 20, 1930.

WALTER C. LINDLEY,
United States District Judge.

818 And on, to wit, the 22nd day of April, A. D. 1930 came the Plaintiff by its attorneys and filed in the Clerk's office of said Court a certain Petition for Appeal in words and figures following, to wit:

Petition for Appeal filed April 22, 1930.

819 * * (Caption) * *

PETITION FOR APPEAL.

To the Judges of Said Court:

The Permutit Company, plaintiff herein, feeling itself aggrieved by the final decree entered in this cause on January 24, 1930, dismissing the bill of complaint herein for want of equity, hereby appeals from said decree to the United States Circuit Court of Appeals, in and for the Seventh Circuit, for the reasons specified in the Assignment of Errors field herewith.

And plaintiff prays that this appeal may be allowed; that a citation be granted, directed to the above-named defendant, commanding it to be and appear before the United States Circuit Court of Appeals for the Seventh Circuit, to do and receive what may appertain to equity and justice in the premises; that a transcript of the record, proceedings and papers upon which said order and decree were made, may be transmitted to and filed with the Clerk of the United States Circuit Court of Appeals for the Seventh Circuit; and that an order may be entered herein fixing the amount of the appeal bond to be given by the plaintiff.

Dated at Chicago, Illinois, April 22, 1930.

THE PERMUTIT COMPANY,
By DYRENFORTH, LEE, CHRITTON & WILES,
Its Solicitors.

(Endorsed) Filed Apr. 22, 1930—Charles M. Bates, Clerk.

Assignment of Errors filed April 22, 1930.

820 And on, to wit, the 22nd day of April, A. D. 1930, came the plaintiff by its attorneys and filed in the Clerk's office of said Court a certain Assignment of Errors in words and figures following, to wit:

821 * * (Caption) * *

ASSIGNMENT OF ERRORS.

Now comes The Permutit Company, plaintiff herein, by its solicitors, and, having prayed an appeal from the decree entered in this cause on January 24, 1930, dismissing plaintiff's

bill heretofore filed in this cause for want of equity, respectfully shows that said decree is erroneous and should be reversed and set aside, for the following reasons:

1. The court erred in dismissing the bill of complaint for want of equity.
2. The court erred in not granting the relief prayed for in the bill of complaint.
3. The court erred in holding that claims 1 and 5 of the Ganz patent in suit No. 1,195,923, granted August 22, 1916, were invalid for want of invention.
4. The court erred in not holding that claims 1 and 5 of said Ganz patent were valid.
5. The court erred in denying the permanent injunction prayed for in said bill of complaint, and in dissolving the temporary injunction entered in said cause.
6. The court erred in not finding the patent sued on was infringed by the defendant.
7. The court erred in not ordering an accounting for damages and profits because of the infringement of the patent
822 in suit by the defendant.
8. The court erred in not entering a decree in accordance with the prayer of the bill of complaint.

Wherefore, and in order that the foregoing Assignment of Errors may be and appear of record in this cause, The Permutit Company, plaintiff herein, presents the same to this court, and prays that such disposition may be made thereof as is in accordance with the law and the statutes of the United States in such case made and provided; and plaintiff further prays that said final decree may be reversed and the District Court be directed to enter a decree in this cause in conformity with the prayer of the bill of complaint.

Dated at Chicago, Illinois, April 22, 1930.

DYRENFORTH, LEE, CHRITTON & WILES,
Solicitors for Plaintiff.

(Endorsed) Filed Apr. 22, 1930. Charles M. Bates, Clerk.

823 And on to-wit: the 22nd day of April, A. D. 1930, the following Order was entered in said Court, to wit:

Entered April 22, 1930.

824 * * (Caption) * *

ORDER ALLOWING APPEAL.

Tuesday, April 22, 1930.

Present: Hon. Walter C. Lindley, District Judge.

Upon motion of solicitors for plaintiff,

It Is Ordered that an appeal to the United States Circuit Court of Appeals for the Seventh Circuit from the final decree heretofore entered herein, be and the same is hereby allowed.

It Is Further Ordered and Decreed that the amount of the appeal bond herein is hereby fixed at the sum of Five Hundred Dollars ($500.00), and that, as said appeal bond is presented at this time to the Court for approval, said bond is hereby approved, and the plaintiff is hereby given thirty days from the entry hereof within which to file its record for appeal.

WALTER C. LINDLEY,
Judge.

April 22, 1930.

O. K.

WILKINSON, HUXLEY, BYRON & KNIGHT,
Counsel for Defendant,

4-19-30.

Filed April 22, 1930.

825 And on to-wit: the 22nd day of April, A. D. 1930, there was filed in the Clerk's office of said court a certain Bond, in words and figures following, to-wit:

826 * * (Caption) * *

BOND.

Know All Men By These Presents: That we, The Permutit Company, a corporation of the State of Delaware, as Principal, and the American Surety Company of New York, a corporation, as surety are held and firmly bound unto the Graver Corporation, defendant in the above entitled cause, in the full and just sum of Five Hundred Dollars ($500.00), to be paid to the said Graver Corporation, its attorneys, successors or

assigns; to which payment, well and truly to be made, we hereby bind ourselves, our successors and assigns, jointly and severally, firmly, by these presents.

Sealed with our Seals and dated this 16th day of April, 1930.

Whereas, lately at a session of the District Court of the United States, for the Northern District of Illinois, in a suit pending in said court between The Permutit Company, plaintiff, and Graver Corporation, defendant, a decree was rendered against the said plaintiff, and in favor of the said defendant, and said plaintiff The Permutit Company having obtained from said court an order allowing an appeal to the United States Circuit Court of Appeals, for the Seventh Circuit, and filed a copy thereof in the Clerk's office of the said court, to reverse the decree heretofore entered in said cause dismissing the bill for want of equity, and a citation di-
827 rected to the said Graver Corporation, citing and admonishing it to be and appear at the United States Circuit Court of Appeals for the Seventh Circuit, to be holden at Chicago within thirty days from the allowance of said appeal;

Now, Therefore, the condition of the obligation is such that if the above-named The Permutit Company shall prosecute said appeal to effect, and shall answer all damages and costs that may be awarded against it if it fails to make its said appeal good, then the above obligation shall be void; otherwise to remain in full force and effect.

THE PERMUTIT COMPANY, (Seal)
By DYRENFORTH, LEE, CHRITTON & WILES,
Its Solicitors.

AMERICAN SURETY COMPANY OF NEW YORK,
By B. H. DAVENPORT,
Res Vice Pres.

Attest:
M. BERG,
Resident assistant Secretary.

Approved:

WALTER C. LINDLEY,
United States District Judge.

O. K. as to form
WILKINSON, HUXLEY, BYRON & KNIGHT,
4-19-30.

(Endorsed) Filed Apr. 22, 1930. Charles M. Bates, Clerk.

May 27, 30. 828 And on to-wit: the 27th day of May, A. D. 1930, came the counsel for the respective parties and filed in the Clerk's office of said Court a certain Stipulation, in words and figures following, to-wit:

829 * * (Caption) * *

STIPULATION.

It is stipulated between counsel for the respective parties that the above and foregoing constitutes the record for appeal to be printed by the Clerk of the Court of Appeals; that the copies therein contained are true and correct copies of the originals from which they purport to have been made; and that the Clerk of the District Court may certify this record as being the record for appeal and as containing true and correct copies of the originals, as stated herein, without comparison with the originals, subject to correction should error be found therein.

Dated, May 8, 1930.

DYRENFORTH, LEE, CHRITTON & WILES,
Council for Plaintiff.

WILKINSON, HUXLEY, BYRON & KNIGHT,
Council for Defendant.

Approved:

WALTER C. LINDLEY,
District Judge.

(Endorsed) Filed May 27, 1930 Charles M. Bates, Clerk.

830 And on, to wit, the 28th day of May, A. D. 1930 came the respective parties by their attorneys and filed in the Clerk's office of said Court a certain Stipulation in words and figures following, to wit:

831 • • (Caption) • • Stipulati May 2

STIPULATION.

It is stipulated between counsel for the respective parties that the following Defendant's exhibits:
Exhibit 14, Pail of zeolites,
Exhibit 15, Rubber gasket,
Exhibit 16, Canvas,
Exhibit 17, Can of Excelsior,
Exhibit 19, Rundschau device,
Exhibit 67, Model G machine built by Duro Corporation, may be retained in the custody of counsel for the defendant, to be produced at the oral argument of the above entitled cause in the Court of Appeals, if desired by counsel for either side, subject to inspection by counsel for plaintiff at any reasonable time preceding or following said argument.

It is further stipulated that said exhibits may be regarded as having been eliminated from the Praecipe filed herein, by agreement of counsel, and that the Clerk of this Court need not certify the above mentioned exhibits to the Court of Appeals, but that they shall have the same force and effect as evidence before the Court of Appeals as if duly certified by the Clerk of the District Court.

Dated at Chicago, Illinois, May 28th, 1930.

GEORGE A. CHRITTON,
Counsel for Plaintiff.

GEO. L. WILKINSON,
Counsel for Defendant.

(Endorsed) Filed May 28, 1930 Charles M. Bates, Clerk.

832 • • (Caption) • • Filed Ma 1930.

APPELLANT'S PRAECIPE FOR RECORD ON APPEAL.

To the Clerk of the United States District Court, For the Northern District of Illinois, Eastern Division:

You will please prepare a transcript of Record to be transmitted to the Circuit Court of Appeals for the Seventh Cir-

cuit, pursuant to the appeal heretofore taken in this case, and include therein the following papers and orders, viz:

Bill of Complaint.
Answer.
Two Amendments to Answer.
Defendant's demand under Equity Rule 58, letter attached thereto, and Plaintiff's answer to said demand.
Opinion of the District Court.
Decree of the District Court.
Plaintiff's Petition for Appeal.
Assignment of Errors.
Order allowing Appeal.
Bond on Appeal.
Citation.
Narrative Statement of Testimony.
Order Approving Narrative Statement.
The following exhibits:

PLAINTIFF'S EXHIBITS.

A. Gans Patent in Suit No. 1,195,923.
Certain stipulations and exhibits as follows:
1. Stipulation dated March 30, 1929.
2. Defendant's bulletin dated February 1, 1923. (Pl. Ex. 10 on Preliminary Injunction).
3. Defendant's bulletin dated June 1, 1925. (Pl. Ex. 11 on Preliminary Injunction).
4. Defendant's bulletin dated October 15, 1927. (Pl. Ex. 12 on Preliminary Injunction).
833 5. Defendant's Model "D" bulletin. (Pl. Ex. 13 on Preliminary Injunction).
6. Blueprint No. C-243. (Pl. Ex. 14 on Preliminary Injunction).
7. Blueprint No. C-242. (Pl. Ex. 15 on Preliminary Injunction).
8. Blueprint No. C-240. (Pl. Ex. 16 on Preliminary Injunction).
9. Defendant's Model "C" bulletin. (Pl. Ex. 30 on Preliminary Injunction).
10. Defendant's bulletin "Soft Water for Textile Purposes." (Pl. Ex. 31 on Preliminary Injunction).
11. Depositions of Norton, Applebaum and Howlett.
12. Exhibit 4 referred to in depositions.
13. Exhibit 5 referred to in depositions.

14. Exhibit 7 referred to in depositions.
15. Exhibit 9 referred to in depositions.
16. Exhibit 10 referred to in depositions.
17. Exhibit 12 referred to in depositions.
18. Stipulations of Plaintiff's test of March 27, 1909 and attached blueprints:
Blueprint ZW-338-A
Blueprint ZW-608
Blueprint C-1941
20. Stipulation of Plaintiff's second test of May 14, 1929 and attached exhibits:
Letter—Cooper, Kerr & Dunham to Mr. Byron.
Letter—Mr. Byron to Cooper, Kerr & Dunham.
Blueprint G-259.
C, D and E Sketches by Witness Tiger.
G. Sketch by Witness Waterman.
I Sketch by Witness Hammer.
J Depositions of Witnesses Haas, Lipsky, Luthy, Bertsche, Mueller, Green, Regan, Scholl, Mason, Noe, Nachman, Stern, Waldbott and Lee.
K, L and M Exhibits printed and numbered 37, 50 and 52, respectively.

DEFENDANT'S EXHIBITS.

18. Report of Permutit Company, dated March 16, 1927, to Florida Filter Corporation.
20. Stipulation dated September 11, 1929.
21. Agreed English translation of German Patent Law.
22. Agreed English translation of German Law on protection of Gebrauchsmuster.
23. Langner testimony in American Chain Company and the C & G Spring & Bumper Company re. Gebrauchsmuster.
24. Rundschau Article of January 27, 1909.
834 25. Translation of article of January 27, 1909.
26. Enlargement of drawings in Rundschau article.
27. The Practical Engineer Article of June 4, 1909.
28. Gebrauchsmuster No. 341,512.
29. Translation of Gebrauchsmuster No. 341,512.
30. Gebrauchsmuster No. 313,671.
31. Translation of Gebrauchsmuster No. 313,671.
32. Feldhoff article of September 7, 1907.
33. Translation of article of September 7, 1907.

34. Leister patent (Ger.) No. 211, 064 of January 23, 1908.
35. Translation of Leister patent (Ger.) No. 211,064, of January 23, 1908.
36. Down-flow softener in Permutit v. Harvey.
37. Down-flow softener in Permutit v. Wadham.
38. Up-flow softener in Permutit v. Paige-Jones (Enjoined).
39. Up-flow softener in Permutit v. Paige-Jones (Not enjoined).
40. Def. drawing of Rundschau water softener.
41. Stipulation of September 14, 1929 and drawing Def. Ex. 40 therein.
42. Stipulation of September 16, 1929, with notice, motion, Rice affidavit and disclaimer attached.
43. Second Stipulation of September 16, 1929.
44. Deposition mentioned in stipulation Def. Ex. 43 (Def. Ex. 44 is printed as Pl. Ex. J).
45. Stipulation of October 18, 1929, re Def. Ex's. 26, 21 and 22 and 23.
46. Stipulation of October 19, 1929.
47. Gans article of April 15, 1909 in Chemische Industrie.
48. British patent No. 3870 of 1911.
49. Duggan patent No. 1,276,629.
50. Gans patent No. 943,535.
51. Gans reissue No. 13,688.
52. Jewell No. 478,261.
53. Bachman No. 678,532.
54. Driesbach No. 630,870.
55. Bommarius No. 632,091.
56. Bommarius No. 707,899.
57. Bommarius No. 519,565.
58. Gans patent No. 960,887.
59. Stipulation dated October 25, 1929, re Weiss Thesis.
60. Weiss Thesis.
61. Translation of portions of Weiss Thesis.
62. Copy of Letter dated March 18, 1920, from Thomas R. Duggan to Charles F. McKenna.
64. Blueprint showing curve referred to by Dr. Moses.
65. Certified copy of Gans file wrapper and contents.
66. Blueprint showing exterior of softener at the Desplaines River sewage plant.

Please certify and transmit as physical exhibits, not to be printed, the following defendant's exhibits:

Exhibit 14, Pail of zeolites.
Exhibit 15, Rubber gasket.
Exhibit 16, Canvas.
Exhibit 17, Can of Excelsior.
Exhibit 19, Rundschau device.
Exhibit 67, Model G machine built by Duro Corporation.

835 You will also please certify and transmit as a physical exhibit, to be returned to the Clerk of the District Court after the oral argument in the Court of Appeals, by agreement of counsel, the original typewritten transcript of the proceedings in the District Court, for such use in the Court of Appeals, on the oral argument, as may be found advisable by court and counsel.

Order Extending Time to File Aecord.
Stipulation as to certificate of record.
Stipulation May 28, 30.
This Praecipe.
The certificate of the Clerk.
Dated, May 27, 1930.

DYRENFORTH, LEE, CHRITTON & WILES,
Counsel for Plaintiff.

WILKINSON, HUXLEY, BYRON & KNIGHT,
Counsel for Defendant.

Approved this 27th day of May, 1930.

WALTER C. LINDLEY,
United States District Judge.

Approved this 27th day of May, 1930.

EVAN A. EVANS,
United States Circuit Judge.

(Endorsed) Filed May 28, 1930 Charles M. Bates, Clerk.

347 And on to-wit: the 1st day of November, A. D. 1929, there was filed in the Clerk's office of said court the following Exhibit, to-wit:

R. GANS.

SOFTENING OF WATER.

APPLICATION FILED AUG. 5, 1911. RENEWED MAR. 26, 1915.

1,195,923.

Patented Aug. 22, 1

Fig. 3.

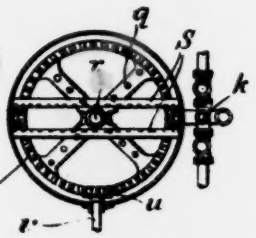


Fig. 1.

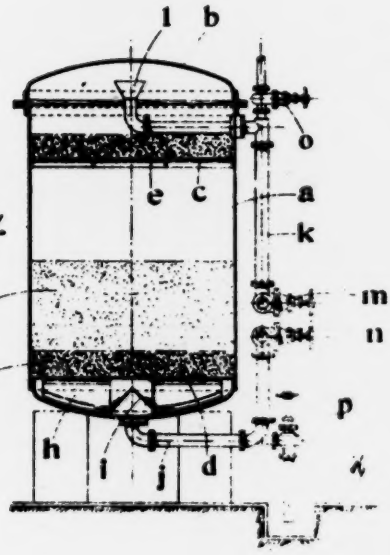
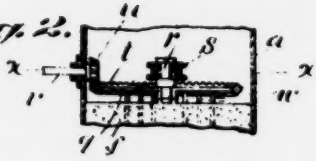


Fig. 2.



Witnesses—

Stanley Moore

H. S. Wilcox

Inventor

Robert Gans

by

Attorney.

UNITED STATES PATENT OFFICE.

Robert Gans, of Berlin, Germany, Assignor to J. D. Riedel Aktiengesellschaft, of Berlin, Germany.

SOFTENING OF WATER

1,195,923. Specification of Letters Patent. Patented Aug. 22, 1916.

Application filed August 5, 1911, Serial No. 642,477. Renewed March 26, 1915. Serial No. 17,244.

To all whom it may concern:

Be it known that I, Dr. Robert Gans, a subject of the German Emperor, residing at Berlin, Germany, (whose post-office address is Pankow, near Berlin, Germany,) have invented certain new and useful Improvements Relating to the Softening of Water, of which the following is a specification.

This invention relates to an apparatus for softening water in the use of zeolites or hydrated alumino-silicates.

It is known that zeolites or hydrated alumino-silicates have the property of softening hard water and the present invention has for its object an apparatus in which the zeolites or alumino-silicates can be used in a filter and be regenerated therein so as to be capable of continuous use for the softening of water.

The zeolites or hydrated alumino-silicates that occur in nature are ill adapted, without special treatment for the purpose, inasmuch as their capacity for the exchange of their base, upon which their property of softening hard water depends, is relatively small, while they have little or no capacity for regeneration or reconversion to their original condition, whereby they can be continuously used.

Furthermore zeolites or hydrated alumino-silicates for use in softening hard water by mere filtration of the hard water through them must not only possess a high capacity for exchange of their base and a high capacity for regeneration or re-conversion to their original condition, but they must be hard and large grained, and adapted by their physical qualities for use as filtering media, for example, those produced according to the process described in my application Serial No. 642383 filed 4th August 1911.

The accompanying drawing illustrates diagrammatically and by way of example a filter provided according to the invention.

In this showing, Figure 1 is a view in central vertical section of an apparatus under the present invention; Fig. 2 is a similar but fragmental view of a modification carrying a stirring device; and Fig. 3 is a horizontal section of the same along line *x*—*x* of Fig. 2.

In carrying the invention into effect as illustrated in the accompanying drawing a vertical cylindrical casing *a* is provided having a coned bottom and closed at the top by a cover plate *b* and within this casing a number of horizontally disposed perforated plates such as *c* and *d* are suitably mounted. The perforated plate *c* carries a layer or layers of quartz or sand through which the water to be softened may be first filtered, while the perforated plate *d* carries a layer of hard coarse grained zeolites *f* through which the water then passes, the layer of zeolites advantageously having a layer *g* beneath of quartz or sand. The water to be softened passes from the supply pipe *k* through the inlet valve *m* and inlet pipe *l* to the filter, passing down the filter layer *e*, thence through the layer of zeolites or alumino-silicates *f* and the layer of sand or quartz *g*, to the water collecting chamber *h*, whence it passes through the conical perforated screen *i*, through the outlet pipe *j* and valve *n*; *j* being located at and drawing from the lowest point of the bottom.

In operation the inlet valve *m* for the water to be softened, as well as the outlet valve *n* are opened and the water then caused to pass through the filter, and to be completely softened thereby.

After the softening property of the zeolites has been exhausted or reduced, which can be readily ascertained by testing the water passed through, the inlet valve *m* and outlet valve *n* are closed, and a solution of a sodium salt such as common salt, is passed through the filter by opening the inlet valve *o* in a pipe leading to a suitable source of supply (not shown) of such salt solution and allowing the solution of salt after passing through the filter to pass outwardly through outlet *j* at the low point of the bottom and thence escape through the waste valve *p*. By such means it will be understood that the passage of water through the filter may be cut off or diverted, and the regenerating solution may then be passed through so that the zeolites may be regenerated, and thus the filter is capable of continuous use without the removal of the zeolites from the filter or their renewal.

It is obvious that as a matter of practical convenience two such filters may be provided, so that one may be used, while the zeolites are regenerated in the other, and thus an uninterrupted supply of soft water provided.

As shown in Figs 2 and 3, means may be provided for stirring the zeolites, as for example in washing, ("back washing") to remove impurities mechanically taken up by the zeolites. Such means may conveniently consist of plate *q* mounted on shaft *r* supported by cross beams *s* in casing *a*. This plate is capable of rotating by means of a series of bevel teeth *t* carried by the plate gearing with pinion *u* operable from outside the casing by means of shaft *v*. The plate may advantageously have secured to it a series of rods *w* passing into the zeolites so that on rotation of the plate the zeolites are stirred. In back washing the silicates by passing a current of water therethrough in the reverse direction from suitable connections in the usual manner for the purpose of removing slime, mechanically collected matters, etc., this stirring is advantageous.

The respective layers of filtering material and zeolites may be contained within perforated or other simular removable casings, let into the filter casing *a*, so that the removal of the filtering material and zeolites from the filter casing may be facilitated when such is at any time required.

What I claim as my invention and desire to secure by Letters Patent is:—

1. A water softening apparatus comprising a casing, a filter bed consisting of a layer of sand or quartz and a layer of zeolites or hydrated alumino-silicates disposed on the layer of sand or quartz, means for permitting the passage of water through the casing, means for cutting off the supply of water on the exhaustion of the zeolites, and means for passing through the casing a solution of a salt capable of regenerating the zeolites.

2. A water softening apparatus comprising a casing, a filter bed within said casing, said filter bed consisting of a layer of sand or quartz and a layer of zeolites or hydrated alumino-silicates disposed on the layer of sand or quartz, means for permitting the passage of water through the casing, means for cutting off the supply of water on the exhaustion of the zeolites and means for passing through the casing a solution of a salt capable of regenerating the zeolites and means for stirring the layer of zeolites.

3. A water softening apparatus comprising a casing, perforated plates disposed one above the other within said casing, layers of quartz or sand on said plates, a layer of zeolites or hydrated alumino-silicates disposed on the lower layer of sand, means for permitting the passage of water through the filter plate, means for cutting off the supply of water on the exhaustion of the zeolites and means for passing through the casing a solution of a salt capable of regenerating the zeolites.

4. A water softening apparatus comprising a casing, perforated plates disposed one above the other within said casing, layers of quartz or sand on said plates, a layer of zeolites or hydrated alumino-silicates disposed on the lower layer of sand, means for permitting the passage of water through the filter plate, means for cutting off the supply of water on the exhaustion of the zeolites and means for passing through the casing a solution of a salt capable of regenerating the zeolites, and means for stirring the zeolites.

5. Water softening apparatus comprising a casing, a filter bed consisting of a layer of zeolites or alumino-silicates, supporting means for said layer, means for permitting the passage of water through the casing, means for cutting off the supply of water on the exhaustion of the zeolites, means for supplying and passing into the casing a solution of a salt capable of regenerating zeolites and means connected to the lowest point of the casing for removing the salt solution so introduced.

6. Water softening apparatus comprising a casing, a filter bed consisting of a layer of water softening materials of zeolitic nature, supporting means for said layer, a supply pipe leading to one end of the casing for supplying hard water, another pipe communicating with the same end, a pipe leading from the other end of said casing for delivering softened water and another pipe also connected to the same end, the pipe connected to the lowest end of the casing being adapted for complete drainage of said casing and the other pipe connected with the same end leading to a place of disposal of waste salt solution and the other pipe communicating with the said other end being connected to a suitable source of revivifying salt solution.

In testimony whereof I have hereunto signed my name to this specification in the presence of two subscribing witnesses.

DR. ROBERT GANS.

Witnesses:

DR. CORNELIUS MASSACIN,

AUGUST HERRMANN.

DISCLAIMER.

1,195,923.—*Robert Gans*, Berlin, Germany. SOFTENING OF WATER. Patent dated August 22, 1916. Disclaimer filed March 2, 1920, by the assignee, by mesne assignments, *The Permutit Company*.

"Hereby disclaims from the scope of claim 1 of Patent 1,195,923, any water softening apparatus including a layer of zeolites or hydrated alumino-silicates disposed on a layer of sand or quartz in which the water to be softened is so introduced into the casing that it passes upwardly through said layer of zeolites."

[*Official Gazette March 16, 1920.*]

(No Model.) 2 Sheets—Sheet 1.

O. H., W. M. & I H. JEWELL.

FILTER.

No. 478,261. Patented July 5, 1892.

Fig. 1.

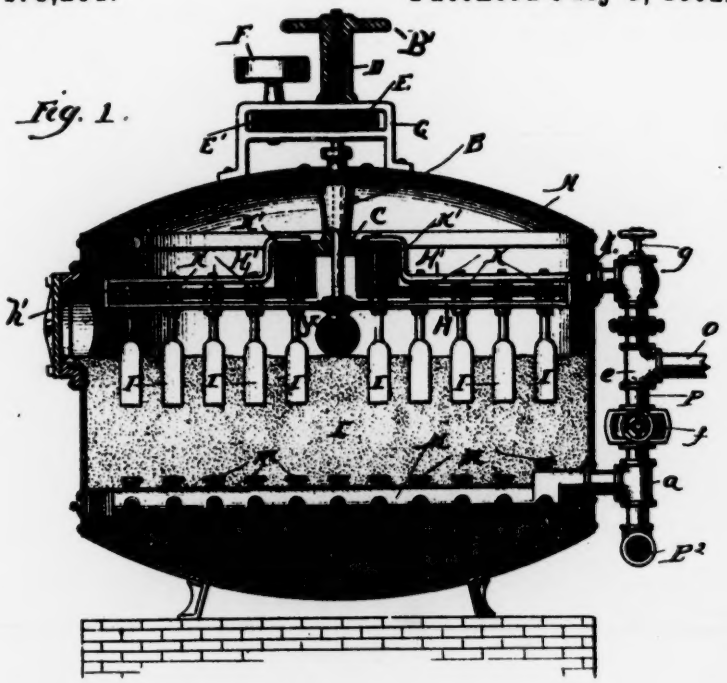
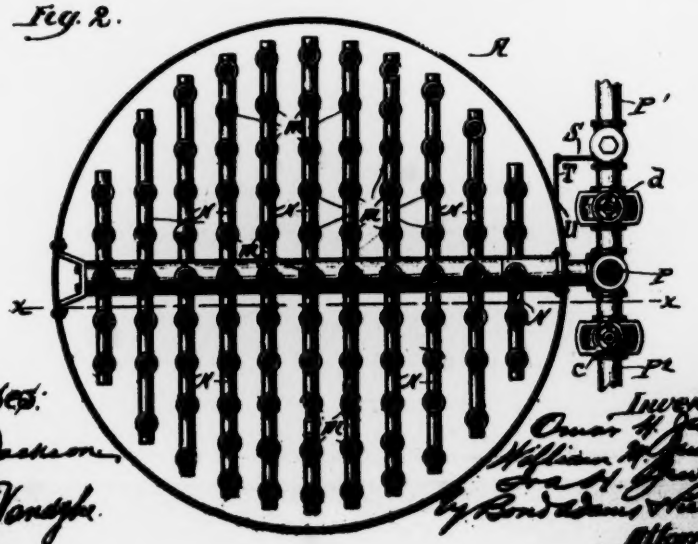


Fig. 2.



Witnesses:

John L. Jackson

Robt. Wendyke

Inventors

Omar H. Jewell

William M. Jewell

Isaac H. Jewell

by Bond Adams & Wells

Attorneys

(No Model.) 2 Sheets—Sheet 2.

O. H., W. M. & I. H. JEWELL.

FILTER.

No. 478,261. Patented July 5, 1892.

Fig. 3

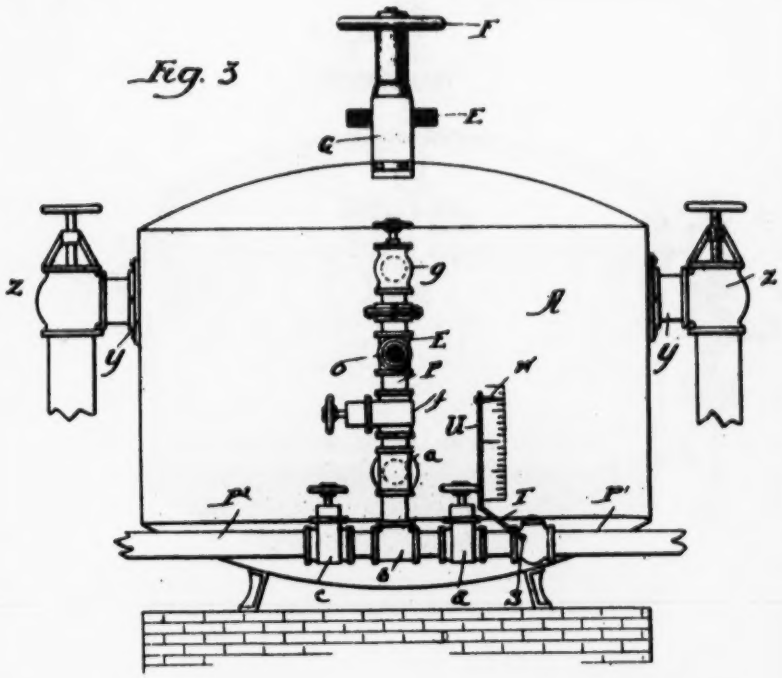


Fig. 4

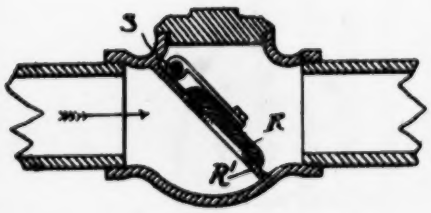
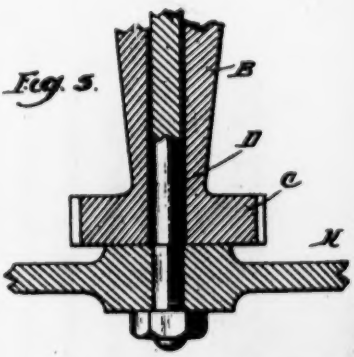


Fig. 5.



Witnesses:
John L. Jackson
Ralph Vandyke

Inventors:
Omar H. Jewell
William M. Jewell
Ira H. Jewell
by Pond Adams & Pickard
Attorneys.

UNITED STATES PATENT OFFICE.

Omar H. Jewell, William M. Jewell, and Ira H. Jewell, of Chicago, Illinois.

FILTER.

SPECIFICATION forming part of Letters Patent No. 478,261, dated July 5, 1892.

Application filed November 17, 1891. Serial No. 412,241. (No model.)

To all whom it may concern:

Be it known that we, OMAR H. JEWELL, WILLIAM M. JEWELL, and IRA H. JEWELL, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Filters, of which the following is a specification, reference being had to the accompanying drawings, in which—

Figure 1 is a vertical cross-section of the filtering-tank on line *x x* of Fig. 2. Fig. 2 is a plan view of the pipes for taking up and conveying away the filtered water and for admitting water to the filter while it is being washed. Fig. 3 is a side elevation of the tank, showing the feeding and distributing pipes, the indicating apparatus, and the wash-out pipes. Fig. 4 is an enlarged detail view of the check-valve in longitudinal vertical section; and Fig. 5 is an enlarged detail, being a partial vertical section of the sleeve with its attached gear-wheel and the driving-shaft.

Our invention relates to improvements in filters for filtering large quantities of water, and particularly to the kind of filters described by us in the specification forming part of Letters Patent of the United States granted to O. H. Jewell and W. M. Jewell, No. 425,573, dated April 15, 1890.

Our object is to provide improved mechanism for agitating the sand while the filter is being washed out, so that the wash-waters may thoroughly cleanse the sand.

In the drawings, A indicates a filtering-tank of any desired form, material, and construction. To the top of the tank and projecting vertically downward from the inside thereof is rigidly secured a sleeve B, having a gear-wheel C at the lower end. The gear-wheel C is preferably formed integral with the sleeve B, as shown in the drawings; but, if desired, it may be rigidly attached to the sleeve in any suitable manner. Through the sleeve B passes a rotating shaft D, which carries a vertically-movable gear-wheel E, which is provided with a feather to prevent its rotation upon the shaft D. The gear-wheel E intermeshes with another gear-wheel E′, provided with a wheel F, by means of which it may be rotated. The various wheels and the shaft D are supported by a frame G at the top of the tank A. Upon the lower end of the shaft D is mounted a horizontal cross-bar H, which is keyed to the shaft D, so as to rotate with it.

H′ indicates bars, one of which is rigidly connected to each end of the bar H by a short upright bar *h′*. The bars H′ extend over and parallel with the bar H to form yokes, as best shown in Fig. 1. The shaft D is somewhat longer than the sleeve B, and its upper end projects through the frame G and is screw-threaded, as shown.

B′ indicates a hand-wheel, which is adapted to screw upon the upper end of the shaft D above the frame G. By this construction the shaft D and bars H H′ may be raised or lowered by operating the hand-wheel.

K K K′ K′ indicate gear-wheels mounted in a horizontal position in the yokes formed by the bars H and H′, and they are so arranged as to mesh successively with each other. The gear-wheels K′ K′, which are nearest the shaft, are prolonged upward, as best shown in Fig. 1, and mesh with the fixed gear-wheel C. The inner ends of the bars H′ extend upward and form bearings for the upper ends of the inner gear-wheels K′.

I I I indicate agitating arms or paddles, the upper ends of which are circular in cross-section and are journaled in suitable bearings in the cross-bars H H′. The paddles I are centrally secured to the different gears K K K′ K′, and their lower ends are broadened to about the shape shown. By this construction when the shaft D is rotated the cross-bar H is rotated in a horizontal plane, carrying with it the gear-wheels K K K′ K′ and the agitating arms or paddles I I I, which by the action of the fixed gear C upon the inner gears K′ K′, and thence to the other adjacent gears, are all rotated about their respective vertical axes.

In use the tank A is partially filled with sand or other similar filtering material, and the object of the paddles I is to agitate the sand when the filter is being washed, as will

be more fully hereinafter described. The paddles I are made of such length that when the bars H H′ and shaft D are at their highest point the lower ends of the paddles will just clear the sand. If the shaft D is then rotated, the water above the sand will be agitated without materially agitating the sand, which is desirable in the process of washing out the impurities. When it is desired to agitate the sand as well as the water, the shaft is moved down by means of the wheel B′ until the paddles extend to the desired distance into the sand.

Near the bottom of the filter-tank, below the filter-sand or other filtering material L, are placed pipes for drawing off the filtered water or for admitting water for washing the filter, as the case may be. This, as is best shown in Fig. 2, consists of the main pipe M, provided with multiple openings, into each of which is tapped a strainer-cup *m*. Into openings upon each side of the pipe M are tapped a number of horizontal pipes N N N, parallel with each other, closed at their outer ends, and provided, like the main pipe, each with a number of strainer-cups *m m*. The main pipe M is closed at one end and at the other passes through the wall of the filter and communicates by means of a T-coupling *a* with the outer pipe P, as is shown in Figs. 1 and 2. The outer pipe P has at its lower end connected with it by a T-coupling *b* two horizontal arms P′ P², provided with the cut-off valves *c d*, one upon each side of the T-coupling *b*. The upright pipe P is connected with the supply-pipe O by means of a T-coupling *e*, placed near the middle of said upright pipe P, and is provided with cut-off valves *f g*, placed, respectively, below and above the supply-pipe O.

The operation of the filter is as follows: When it is desired to filter water, the cut-off valve *g* is opened, the cut-off valves *f* and *c* are closed, and the cut-off valve *d* opened. The water admitted by the supply-pipe O passes into the pipe P through the open valve *g* and is discharged into the filtering-chamber. Passing down through the filtering-sand or other substance L, it enters the pipes M N N through the strainer-cups *m m m* and is discharged by the pipe M into the pipe P below the closed valve *f* and thence through the open valve *d* and the pipe P′ to any desired place.

In the pipe P′ is placed a check-valve, consisting of a valve R, hinged at its upper end and resting in an inclined position upon a seat R′, as shown in Fig. 4. The valve R is adapted to permit the water to flow through the pipe P′ in the direction indicated by the arrow in Fig. 4, but to prevent it from flowing in the other direction.

S indicates a pin, which is secured to the valve R at its pivotal point and projects horizontally through the side of the valve-chamber and carries an arm T, which is rigidly attached to the pin S and moved as the valve R rises or falls. The arm T carries a vertical rod U upon its outer or free end, pivotally attached to it and carrying an index-finger or pointer W at its upper end. The index-finger W moves up and down a scale suitably arranged. In the drawings we have shown the scale marked on the side of the tank; but, if desired, it may be otherwise arranged. As the water flows through the pipe P′ in the direction indicated by the arrow in Fig. 4 the valve R rises, turning the pin S and lowering the arm T, and with it the vertical arm U and the index-finger or pointer W along the scale X. The greater the quantity of water flowing through the pipe P′ the higher the check-valve R will be lifted and the lower the index-finger W will fall, thus indicating the volume of water flowing through the filter. The index will in use be so adjusted that when the check-valve R is closed the index-finger or pointer W will stand at zero in the scale.

For the purpose of washing out the filter the filtering-tank is provided with one or more wash-out pipes Y Y, located on a level with the top of the filter-sand, as shown in Fig. 1, and provided with suitable stop-valves Z Z and pipe leading to the sewer, as shown in Fig. 3. When it is desired to wash out the filter, the valve *f* is opened, the valves *g*, *c*, and *d* are closed, and the valves Z Z in the wash-out pipes opened. The water thus flows into the pipe P downward through the T-coupling *a* into the pipes M N N N, whence it flows through the strainer-cups *m m* up through the filter-sand and out through the wash-out pipes Y Y. At the same time the agitating apparatus is set in motion and the agitating arms or paddles I I are revolved through the filter-sand, as above described, thoroughly agitating it and causing a com-

plete and perfect cleansing thereby. By operating the wheel B′ as above described the paddles I may be moved vertically in the sand or they may be raised entirely out of the sand, if desired. The object of locating the wash-out pipes on a level with the top of the sand is to give easy egress to the impurities which by the rotary motion of the water and filter-sand will accumulate near the top of the sand and near the circumference of the tank.

When the filter is cleansed and is again ready to be set in operation to filter water, the valves are reset, as above described, for the filtering process, except that the valve *d* is first closed and the valve *c* opened. As it frequently happens after washing out the filter that some very fine dirt is left in the filter, which causes the water to run out somewhat muddy at first, by opening the valve *c* and closing the valve *d* the water filtered immediately after washing is permitted to escape through the pipe P^2 into the sewer. When the water runs clear, the valve *c* is again closed and the valve *d* opened, when the filtering process goes on as first above described.

That which we claim as new, and desire to secure by Letters Patent, is—

1. The combination, with a filtering-tank A, of a pendent sleeve B, having a fixed gear-wheel C at its lower end, a frame G above the tank, a vertically-movable shaft D, extending through the sleeve and having a screw-threaded upper end, a horizontal cross-bar H, secured to the shaft below the sleeve and having gear-wheels K′, which remain in mesh with the fixed gear-wheel as the shaft and cross-bar are raised and lowered, the agitator-arms I, journaled to the cross-bar and geared to the gear-wheels carried by the latter, means for rotating the shaft, and a hand-wheel B′, engaging the screw-threaded portion of the shaft to raise and lower the same, substantially as described.

2. The combination, with a filtering-tank A, of a pendent sleeve B, suspended from the top wall of the tank and having a fixed gear-wheel C at its lower end, a frame G, arranged above the tank, a vertically-movable shaft D, extending through the sleeve and frame and having a screw-threaded upper end, a horizontal cross-bar H, secured to the shaft below the sleeve and having gear-wheels which remain in mesh with the fixed gear-wheel as the shaft and cross-bar are raised and lowered, the agitator-arms I, journaled in the cross-bar and geared to the gear-wheels carried by the latter, a gear-wheel E, mounted on the shaft within the frame above the tank and through which wheel the shaft is adapted to move lengthwise, a gear-wheel E′, carried by the frame, a drive-pulley F, and a hand-wheel B′, engaging the screw-threaded portion of the shaft above the frame, substantially as described.

OMAR H. JEWELL.
WILLIAM M. JEWELL.
IRA H. JEWELL.

Witnesses:
ALBERT H. ADAMS,
JOHN L. JACKSON.

(No Model.)

F. BOMMARIUS.

FILTER.

No. 519,565. Patented May 8, 1894.

Fig. 1

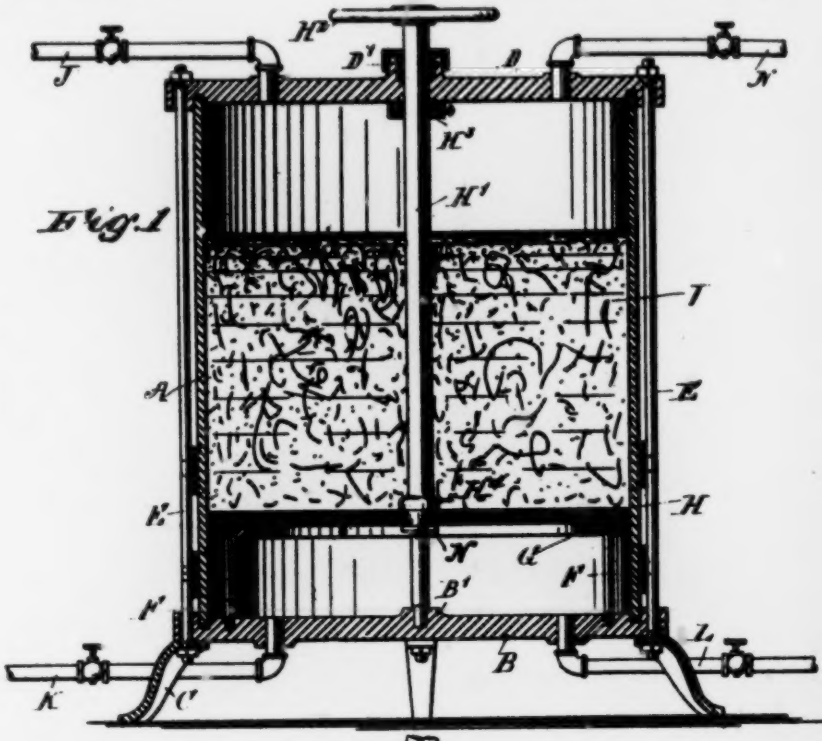
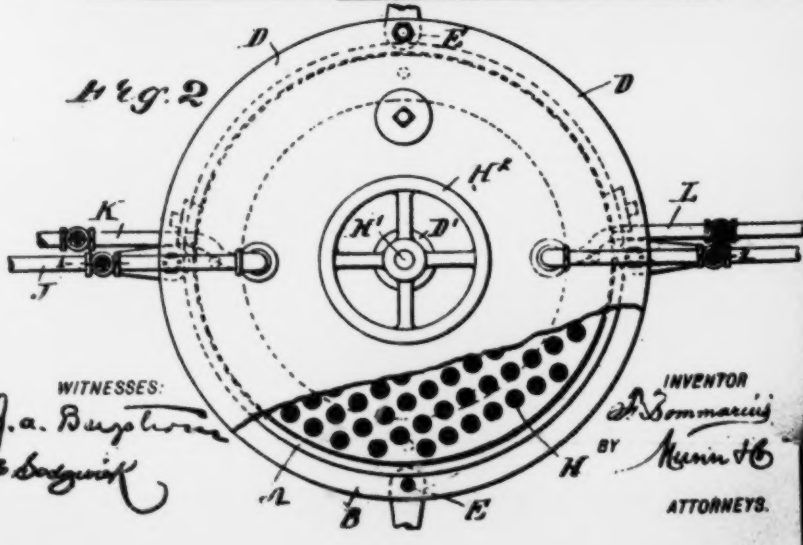


Fig. 2



WITNESSES:

J. a. Bagley

E. Sedgwick

INVENTOR

F. Bommarius

BY

Munn & Co

ATTORNEYS.

UNITED STATES PATENT OFFICE.

Frederick Bommarius, of New Orleans, Louisiana.

FILTER.

SPECIFICATION forming part of Letters Patent No. 519,565, dated May 8, 1894.

Application filed August 25, 1898. Serial No. 484,028. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK BOMMARIUS, of New Orleans, in the parish of Orleans and State of Louisiana, have invented a new and Improved Filter, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved filter, which is simple and durable in construction, very effective in operation, designed for high or low liquor pressure, more especially designed for filtering water used for drinking and other purposes, and arranged to permit of conveniently and thoroughly cleaning the filtering material whenever necessary.

The invention consists of certain parts and details and combinations of the same, as will be hereinafter described and then pointed out in the claim.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in both the figures.

Figure 1 is a sectional side elevation of the imprivement on the line 1—1 of Fig. 2; and Fig. 2 is a plan view of the same, with parts broken out.

The improved filter is provided with a casing A, preferably made cylindrical and closed at its lower end by a head B, provided with legs C for conveniently supporting the filter on a table or other suitable support. The upper end of the casing A is closed by a head D connected by screw bolts E within the lower head B, so as to hold the heads securely to the casing.

On the lower head B are secured upwardly-extending rods F, carrying at their upper ends a ring G arranged a suitable distance above the head B within the casing A and at the interior surface thereof. On this ring G is seated a revoluble screen H, preferably made of two perforated plates with a wire netting between the same. The screen H is secured on a shaft H′, arranged centrally within the casing A and mounted to turn with its lower end in a step B′ formed on the upper surface of the lower head D. The screen H may be removed from the shaft, as it is held between a collar H^4 formed on the shaft, and a jam nut N engaging a screw-threaded portion of the shaft. The upper end of the shaft H′ extends through a suitable stuffing box D′, arranged on the upper head D, and on the outer end of the said shaft H′ is secured a hand wheel H^2 for conveniently turning the said shaft and the screen H secured to the shaft. On the shaft H′ is also secured, by a set screw, a collar H^3, abutting against the under side of the upper head B, so as to prevent the screen H from being unseated on the ring G, in case of an upward pressure on the under side of the screen. The filtering material I is placed in the upper part of the casing A so as to rest on the screen H, as plainly shown in the drawings. The water to be filtered is passed through a valved pipe J, into the upper end of the casing A, the said pipe passing through the head D; a valved pipe K leading from the lower head B serves to withdraw the filtered water from that part of the casing extending between the head B and the ring G and screen H. In order to clean the filtering material, I provide a valved pipe L, leading into the lower part of the casing A, through the head B, and a valved pipe N leads from the upper part of the said casing and is connected with the head D. When the several parts are in the position shown in the drawings, and the valves in the pipes L and N are closed and the valves in the pipes J and K are open, then the water to be filtered, flows through the pipe J into the casing A and filters through the material I and the screen H into the lower part of the casing A, to finally pass, in a filtered condition, out of the casing through the pipe K. When the filtering material I becomes filled with impurities and it is necessary to wash the filter, then the valves in the pipes J and K are closed and the filtering process is temporarily interrupted. The pipes L and N are then opened so that the water flows through the pipe L into the lower part of the casing A through the screen H and filtering material I, to finally pass out through the pipe N, carrying along the impurities contained in the filtering material. In order to agitate the filtering material I while this process of washing is going on, the operator turns the hand wheel H^2 so as to revolve the screen H, thereby causing the loosening of the filtering material I and the breaking up of the germs previously formed during the process of filtering

the water. By this arrangement the entire filtering material will be broken up so that the water can readily wash the filtering material and remove the impurities which will flow out with the water through the pipe N. When the filtering material has been sufficiently cleaned, the valves in the pipes L and N are again closed, so that the filtering material again settles in the casing A, resting on the screen H. When the valves in the pipes J and K are again opened, then the process of filtering the water again proceeds, as above described.

It will be seen that the operator can conveniently and readily agitate the filtering material during the process of washing by revolving the screen H, so that all the impurities are rapidly removed and the filter is properly cleaned.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

A filter, comprising a casing provided with inlets and outlets, a shaft journaled in bearings at the top and bottom of the casing, and provided with a collar and a screw-threaded portion, a screen adapted to removably fit on the shaft, a jam nut adapted to engage the threaded portion of the shaft to press the screen against the collar so as to compel the screen to rotate with the shaft, and a stationary ring held in the casing a suitable distance above the bottom to form a seat on which the marginal portion of the screen is adapted to slide during its rotation, substantially as described.

FREDERICK BOMMARIUS.

Witnesses:
JNO. J. WARD,
CHAS. M. HERO.

602

No. 630,870. Patented Aug. 15, 1899.

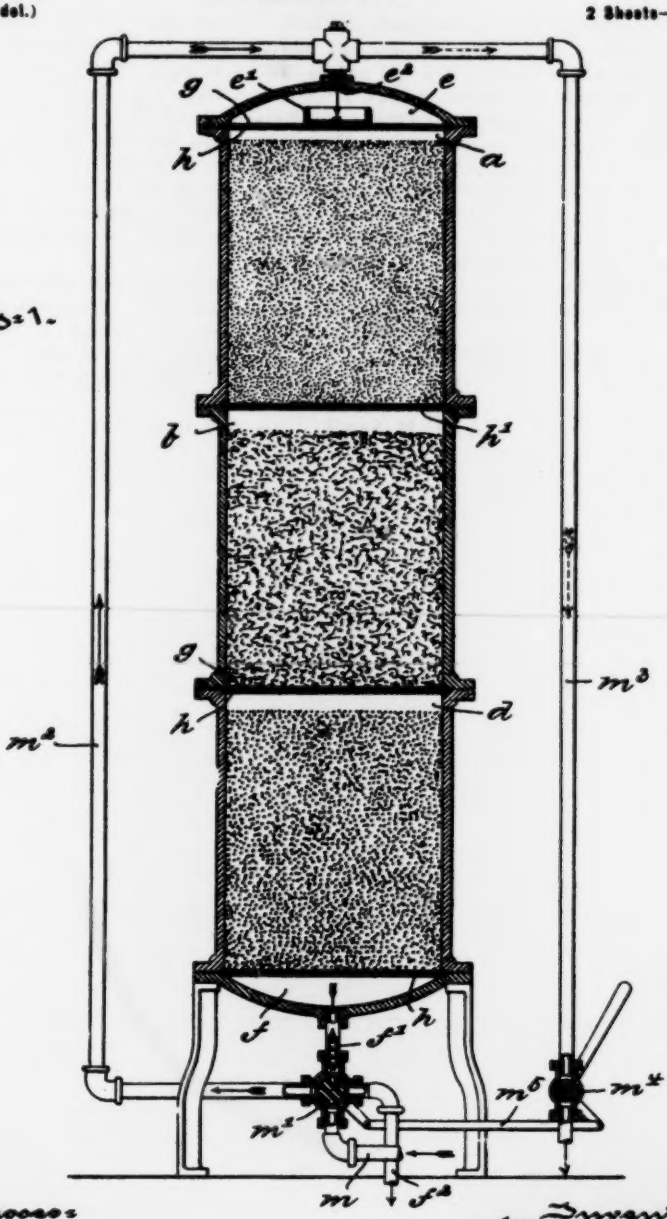
V. C. DRIESBACH.

FILTERING APPARATUS.

(Application filed Apr. 26, 1899.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.



Witnesses:
Thomas M. Smith.
Richard C. Mapurll

Inventor:
Victor C. Driesbach
by J. Walter Boyle
Attorney.

No. 630,870 Patented Aug. 15, 1899.

V. C. DRIESBACH.

FILTERING APPARATUS.

(Application filed Apr. 26, 1899.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 2.

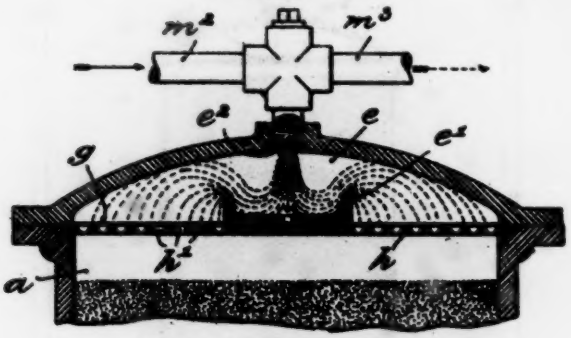
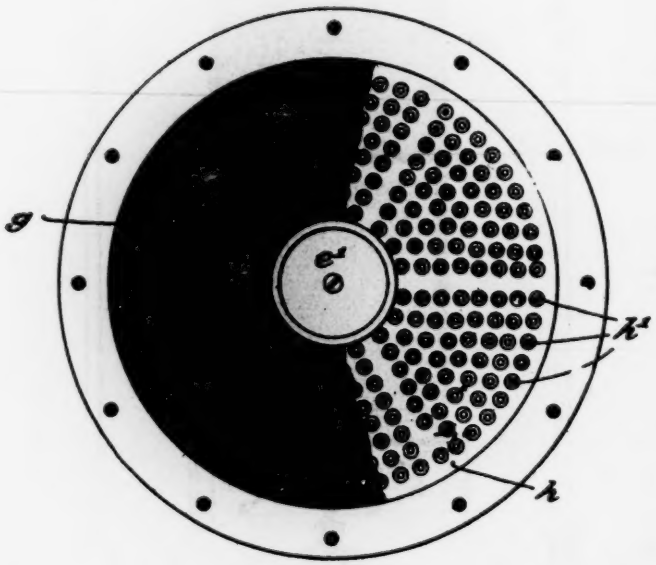


Fig. 3.



Witnesses:
Thomas M. Smith.
Richard C. Mahnell

Inventor:
Victor C. Driesbach,
by J. Walter Dwight
Attorney

UNITED STATES PATENT OFFICE.

Victor C. Driesbach, of Philadelphia, Pennsylvania.

FILTERING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 630,870, dated August 15, 1899.

Application filed April 28, 1899. Serial No. 714,789. (No model.)

To all whom it may concern:

Be it known that I, VICTOR C. DRIESBACH, a citizen of the United States, residing at the city of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Filtering Apparatus, of which the following is a specification.

My invention has relation to an apparatus for filtering water or other liquids, and in such connection it relates more particularly to the construction and arrangement of such an apparatus.

The principal objects of my invention are, first, to provide a simple, comparatively inexpensive, and easily-operated apparatus for the filtering of water; second, to provide in such an apparatus a series of superposed compartments containing the filtering material in conjunction with a liquid-inlet compartment below which the filtering-compartments are arranged, said inlet-compartment being provided with means whereby the liquid is broken up or finely distributed and aerated prior to passing through the filtering-compartments, and, third, to provide in such an apparatus means whereby the apparatus may be quickly and thoroughly cleaned.

My invention, stated in general terms, consists of a filtering apparatus constructed and arranged in substantially the manner hereinafter described and claimed.

The nature and scope of my invention will be more fully understood from the following description, taken in connection with the accompanying drawings, forming part hereof, in which—

Figure 1 is a vertical sectional view of a filtering apparatus embodying the main features of my invention, the pipe connections and cleaning mechanism being illustrated partly in elevation and partly in section. Fig. 2 is an enlarged vertical sectional view of the upper or inlet section of the filtering apparatus; and Fig. 3 is an enlarged top or plan view of the filtering apparatus, partly broken away to more clearly illustrate certain parts of the said apparatus.

Referring to the drawings, the filter comprises a series of superposed compartments *a*, *b*, and *d*, above the upper compartment *a* of which is arranged the water-inlet compartment *e*. In each compartment *a* or *b* or *d* is placed appropriate filtering material or media, which material is usually quartz or coarse sand for the compartment *a*, a clarifying compound or agent for the compartment *b*, and charcoal or similar purifying agent for the compartment *d*. Below the compartment *d* is arranged a collecting-compartment *f*, from which the purified and filtered liquid is drawn off through the pipe *f'*. Each compartment *a*, *b*, and *d* is separated from the adjacent compartments by, first, a screen-plate *g* of fine netting or wire, and, second, a perforated supporting-plate *h* of sheet metal, the perforations *h'* of which are reversely conical, as illustrated in Figs. 2 and 3. In the inlet-compartment *e* and upon the plates *g* and *h* is located a box or trough *e'*, arranged directly below the water-inlet e^2 to the compartment *e*. The function of this box or trough *e'* is to receive and deflect the water issuing from the inlet e^2, so that the same is intimately mingled with air and thoroughly broken up into fine particles before it passes through the netting *g* and plate *h*. The advantages of such a construction are mainly that the water is properly aerated and is delivered to the whole surface of the screen-plate instead of being precipitated upon a portion only.

The preferred arrangement of pipes, as well as the preferred manner of cleaning the filter, is illustrated in Fig. 1. The water or service pipe *m* terminates in a four-way valve *m'*, which when turned as indicated in Fig. 1 permits the water to pass by the pipe m^2 to the top of the filter and to enter by the inlet e^2. After being filtered the water passes out of the base of the filter by the pipe *f'* and through the valve *m'* to the offtake-pipe f^2. From the inlet e^2 extends a branch pipe m^3, controlled by a valve m^4. The handles of the valves *m'* and m^4 are connected together by a link m^5 in such a manner as that when the valve m^4 is closed the valve *m'* is turned so that a connection is made between the pipes *m* and m^2 and pipes *f'* and f^2. When, however, the valve m^4 is opened, the valve *m'* is turned so that the connection of the pipe *m* with the pipe m^2 and the pipe *f'* with the pipe f^2 is closed and the following new connections are made: The pipe *m* is connected directly with

the outlet-pipe f' and water is forced through the filter in a reverse direction, escaping through the inlet e^2 and passing out by the pipe m^3 into a sewer or other receptacle therefor.

Having thus described the nature and objects of my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a filtering apparatus, a series of superposed filtering-compartments, an inlet-compartment arranged above the filtering-compartments, a screen-plate of fine netting and a plate having reversely conical perforations and located below the screen-plate and both plates adapted to separate the inlet-compartment from the first in series of filtering-compartments, and a box or trough supported by said screen and perforated plates directly beneath the inlet of the inlet-compartment, said box or trough adapted to receive and break up the liquid prior to its delivery to the screen and perforated plates, substantially as and for the purposes described.

2. In a filtering apparatus, a series of superposed filtering-compartments, an inlet-compartment arranged above the filtering-compartments, a screen-plate adapted to separate the inlet-compartment from the first in series of filtering-compartments, a box or trough supported by said screen-plate and adapted to receive and break up the liquid prior to its delivery to the screen-plate, a collecting-compartment located below the filtering-compartments, a water-supply pipe having a connection to the inlet-compartment, an outlet-pipe leading from the collecting-compartment, an offtake-pipe and a valve adapted when turned in one direction to open communication between the water-supply pipe and inlet-pipe and between the outlet and offtake pipes and when turned in an opposite direction to open direct communication between the water supply and outlet pipes to clean the filter, substantially as and for the purposes described.

In testimony whereof I have hereunto set my signature in the presence of two subscribing witnesses.

VICTOR C. DRIESBACH.

Witnesses:
J. WALTER DOUGLASS,
RICHARD C. MAXURE.

608

No. 632,091. Patented Aug. 29, 1899

F. BOMMARIUS

FILTER.

(Application filed Apr. 1, 1899.)

(No Model.)

Fig. 1.

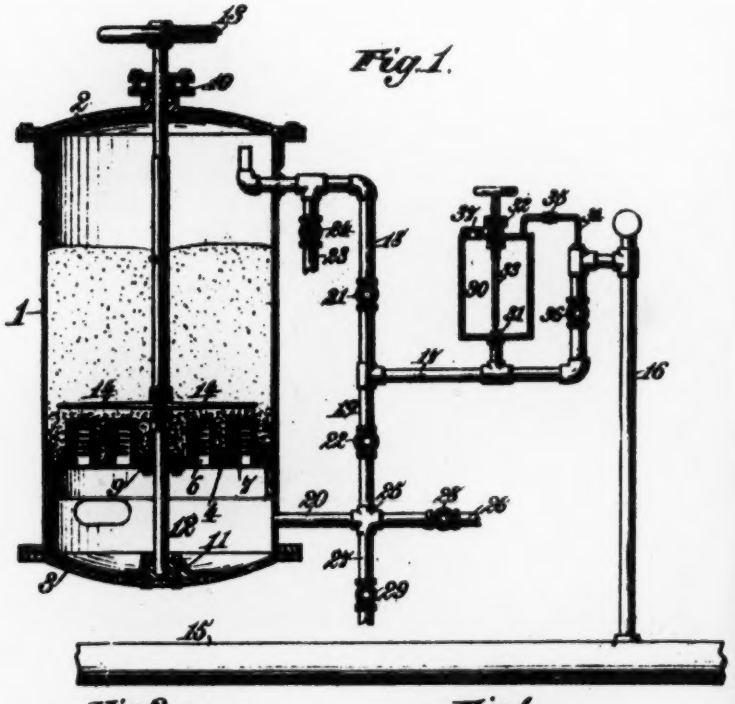


Fig. 2.

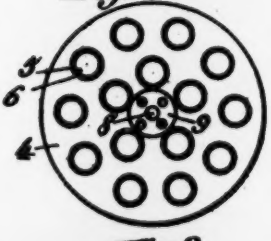


Fig. 4.

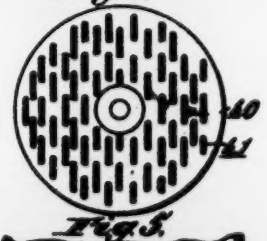


Fig. 3.

Fig. 5.

Witnesses:
Robt. Sinnott.

Inventor:
Frederick Bommarius
By W. H. Gr...
Atty.

UNITED STATES PATENT OFFICE.

Frederick Bommarius, of New Orleans, Louisiana, Assignor to Frederick Henry Bommarius, of Same Place.

FILTER.

SPECIFICATION forming part of Letters Patent No. 632,091, dated August 29, 1899.

Application filed April 1, 1899. Serial No. 711,398. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK BOMMARIUS, a citizen of the United States, residing at New Orleans, parish of Orleans, State of Louisiana, have invented certain new and useful Improvements in Filters, of which the following is a specification.

This invention relates to filters; and it has for its object to provide a filter of improved construction in which impure water may be thoroughly filtered and the filtering medium readily cleansed from time to time and the foreign substances and impurities precipitated and discharged from the filter.

A further object of the invention is to improve and simplify the construction and render more efficient the operation of the class of filters referred to.

To these ends my invention consists in the features and in the construction, combination, and arrangement of parts hereinafter described and particularly pointed out in the claims following the description, reference being had to the accompanying drawings, forming a part of this specification, wherein—

Figure 1 is a view in vertical section of my improved filtering apparatus. Fig. 2 is a detail plan view of the perforated diaphragm arranged in the bottom portion of the filter-casing. Fig. 3 is a similar view of the stirrer-arm. Figs. 4 and 5 are detail views of a modification.

Referring to the drawings, the numeral 1 indicates the filter-casing, preferably comprising a cylindrical sheet-metal vessel flanged at its opposite ends and having attached thereto the top and bottom heads 2 and 3. A flanged head or diaphragm 4 is disposed transversely in the casing 1 at a suitable distance above the bottom head 3 and is secured in place, preferably, by riveting its flanged head to the wall of the casing and calking or otherwise suitably packing it to prevent the passage of filtering material about its edge. As shown most clearly in Fig. 2 of the drawings, the diaphragm 4 is provided with a number of perforations 5, and in each of said perforations is fitted one end of a short tube 6, which is closed at its opposite end, and intermediate its ends is provided with a number of narrow slits 7, formed transversely through the vertical walls of the tubes. The tubes 6 may be screwed or expanded in the perforated diaphragm in manner similar to securing boiler-tubes in place. A vertical perforation 8 is formed in the diaphragm, and secured to the opposite sides of the latter about said perforation are bearing or bushing plates 9.

In the upper head 2 of the casing is arranged a stuffing-box 10, and to the lower head 3 is riveted a step-bearing 11. Passing through the stuffing-box 10 and stepped at its lower end in the bearing 11 is a shaft 12, provided at its upper outer end with a hand-wheel 13. The upper and lower portions of the shaft 12 are round, as clearly indicated, to form an easy bearing for the shaft in the stuffing-box 10 and bearing-plates 9, and between said round portions is preferably square or angular in cross-section. Fixed on the shaft 12 immediately above the upper ends of the slitted tubes 6 is a perforated stirrer-arm formed in two half-sections 14, the adjacent ends of the sections being flanged and provided with V-shaped recesses, as most clearly shown in Fig. 3. The flanged and recessed ends of the two sections of the stirrer-arm are bolted about the squared portion of the shaft 12, thus tightly fixing said arm on the shaft in an obvious manner.

The numeral 15 indicates a water-main and 16 a service-pipe, hydrant, or the like connected therewith. Leading from the pipe 16 is a water-feed pipe 17, connected at its opposite end to a branch pipe 18 19, one branch 18 of which enters the upper portion of the filter-casing and the other branch 19 is connected with the lower portion of the said casing by a pipe connection 20. Valves 21 and 22 are respectively arranged in the branches 18 and 19, and a waste-pipe 23 is connected to the upper end of the branch 18 and is provided with a valve 24. A four-way coupling 25 connects the branch 19 to the connecting-pipe 20, and also connects said pipes with an outlet or draw-off pipe 26 and a waste-pipe 27, respectively provided with valves 28 and 29.

Supported on the feed-pipe 17 is a chemical-receiving vessel 30, comprising a vertical cylindrical closed vessel provided at its bot-

tom with a conical valve-seat 31, that is in communication with the feed-pipe 17, as shown. Through a gland 32, formed in the top of the vessel 30, is screwed a threaded needle-valve stem 33, that is adapted to seat in the valve-seat 31. A small by-pass pipe 34 leads from the upper end of the vessel 30 to the water-supply pipe and is provided with a valve 35, while in the feed-pipe 17 at a point between the points at which the chemical-receiving vessel is connected thereto is arranged a valve 36.

In practice coarse filtering material—such as gravel, for example—will be first placed in the casing over the diaphragm 4 and slitted tubes 6, and this will be surmounted by finer filtering material—as sand, for example—to a suitable height. A quantity of any chemical material suitable for purifying the water and precipitating the impurities—such as alum, for example—is placed in the vessel 30, and for this purpose I preferably form an opening in the top of the vessel normally kept closed by a cap or cover 37.

Constructed as above described the operation of my apparatus is as follows: To place the filter in position for use in filtering and purifying water, partly open valve 36, open wide the valves 21 and 28, and finally open the valve 35 and very slightly raise the valve 33. All the other valves should remain closed. Water will now pass through the feed-pipe 17, branch pipe 18 into the upper part of the filter, down through the filtering material and slitted tubes into the bottom of the casing, and finally out through the outlet-pipe 26. A portion of the supply, however, passes by way of the small by-pass 34 into the vessel 30 and forces a small quantity of alum into the feed-pipe 17, where it immediately mixes with the feed-water and passes with the latter to the filter-bed, thus purifying the water and precipitating foreign substances.

When it becomes necessary to wash out the filter, close the valves 21 and 28 and open the valves 22 and 24. The course of the water through the filter will now be reversed—that is to say, it will pass from pipe 17 down branch pipe 19 and by connecting-pipe 20 into the bottom of the filter, thence up through the slitted tubes and filter-bed and out through the waste-pipe 23, washing out and discharging all impurities. During this operation the hand-wheel 13 should be turned, so as to rotate the stirrer-arm 14 and disintegrate and loosen up the filter-bed, whereby the impurities and foreign substances are liberated and permitted to be carried off by the wash of the water. After the filter-bed has been thoroughly washed out and the filter again been placed in condition for filtering the valve 28 should at first be closed and the valve 29 opened and this condition maintained until the water discharged by the waste-pipe is perfectly clear, when the valve 29 should again be closed and the valve 28 opened, restoring the apparatus to its normal position.

In Figs. 4 and 5 of the drawings I have shown a modified construction of parts designed to be substituted for the diaphragm 4 and slitted tubes 6, before described. As shown in the said figures of the drawings, two perforated heads 38 and 39 are secured in the lower portion of the casing 1, and arranged between said heads is a circular disk 40, of thin sheet brass, provided with a number of narrow slits 41. As before stated, such an arrangement may be substituted for the diaphragm 4 and tubes 6, the construction and operation of the filter in all other respects remaining the same.

Having described my invention, what I claim is—

1. In a filter, the combination with the filter-casing having an inlet and an outlet, of a perforated diaphragm fitted in the casing, horizontally-slitted tubes each open at its lower end and closed at its upper end, the lower open ends of said tubes being fitted in the perforations in the diaphragm, a filter-bed arranged above the diaphragm, a bearing in the diaphragm, a stuffing-box in the upper head of the casing, a step-bearing in the lower head, a vertical shaft passing through said stuffing-box and bearing and stepped in the step-bearing, a perforated stirrer-arm fixed on the shaft above the slitted tubes, and a hand-wheel fixed on the shaft outside the casing, substantially as described.

2. In a filter, the combination with the filter-casing having an inlet and outlet, of a diaphragm fitted in the casing and provided with narrow slitted water-passages, a filter-bed above the diaphragm, a vertical shaft journaled in the casing, a hand-wheel fixed on the shaft outside the casing, and a stirrer-arm fixed on the shaft above the diaphragm said stirrer-arm being formed in two half-sections flanged and angularly recessed at their adjacent ends, said flanged ends being bolted upon an augular portion of the shaft, substantially as described.

3. The combination with the filter casing and bed, of an inlet and outlet pipe, a water-

feed pipe connected with the inlet-pipe and with a pressure-supply pipe, a chemical-containing vessel provided at its bottom with a conical valve-seat communicating with the water-feed pipe, a contracted and valved by-pass pipe connecting the upper part of said vessel with the water-feed pipe, a threaded needle-valve fitted in a bushing in the top of the chemical-containing vessel and arranged to seat in the conical valve-seat, and a hand-wheel fixed on the outer end of the needle-valve, substantially as described.

4. The combination with the filter casing and bed, of a water-feed pipe leading from a pressure-supply pipe, a chemical-containing vessel in valved communication at its bottom with the water-feed pipe, a contracted and valved by-pass pipe connecting the upper part of said vessel with the pressure-supply pipe, valved branch pipes leading from the water-feed pipe to the opposite ends of the filter-casing, valved waste-pipes leading from each of the branch pipes, and an outlet-pipe leading from one of them, substantially as described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

FREDERICK BOMMARIUS.

Witnesses:
W. H. Cook,
Felix J. Puig.

No. 678,532. Patented July 16, 1901.

F. E. BACHMAN.

FILTER.

(Application filed Oct. 31, 1900.)

(No Model.) 3 Sheets—Sheet 1

Fig. 1.

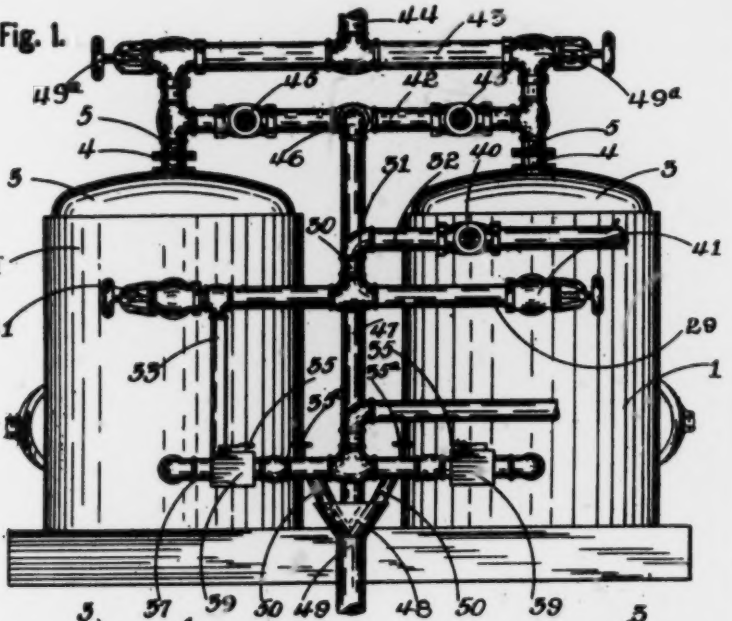
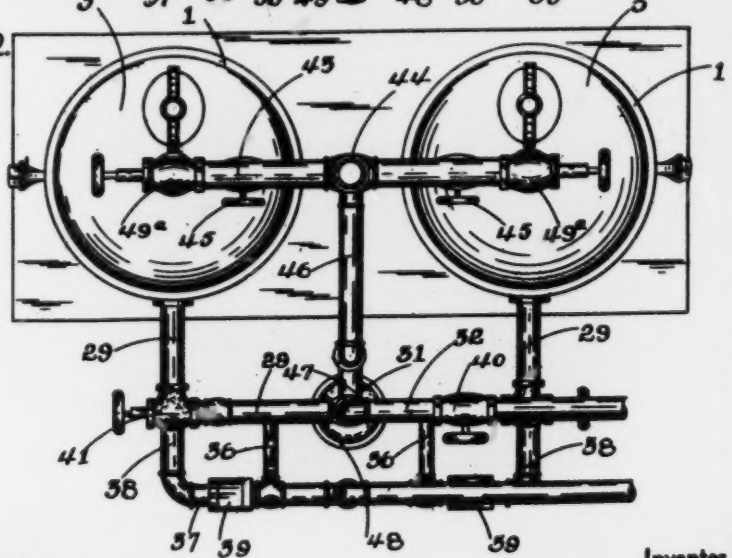


Fig. 2.



Witnesses.

L. M. Sangster

Geo. A. Neubauer

Inventor.

Frank E. Bachman

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Attorney.

No. 678,532. Patented July 16, 1901.

F. E. BACHMAN.

FILTER

(Application filed Oct. 21, 1900.)

(No Model.) 3 Sheets—Sheet 2.

Fig. 4.

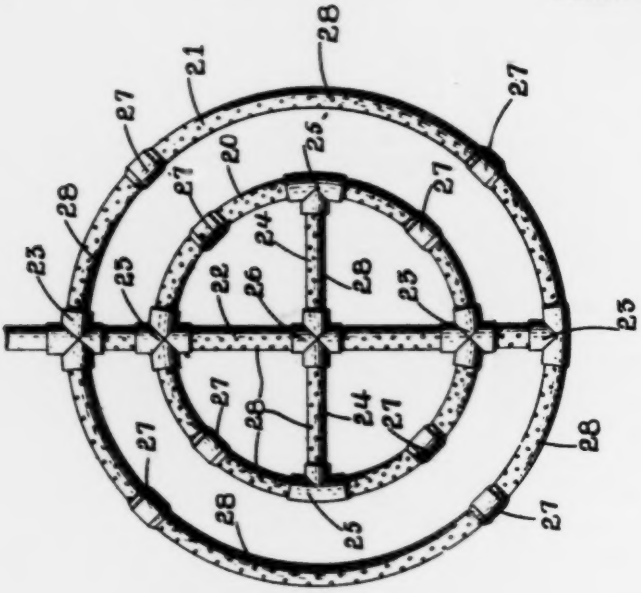
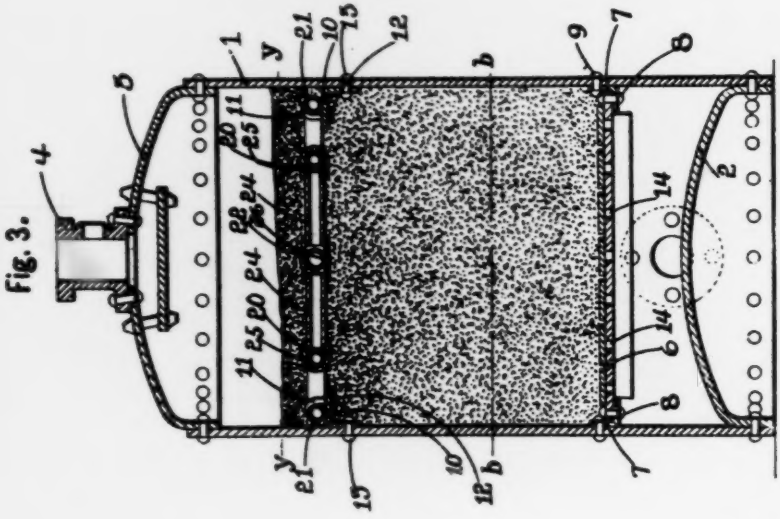


Fig. 3.



Witnesses.

L. M. Sangster.

Geo. A. Neubauer.

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Frank E. Bachman

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618

No. 678,532. Patented July 16, 1901.

F. E. BACHMAN.

FILTER.

(Application filed Oct. 31, 1900.)

(No Model.) 3 Sheets—Sheet 3.

Fig. 5.

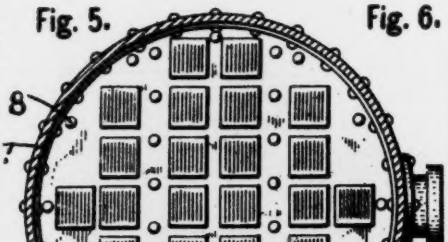

Fig. 6.

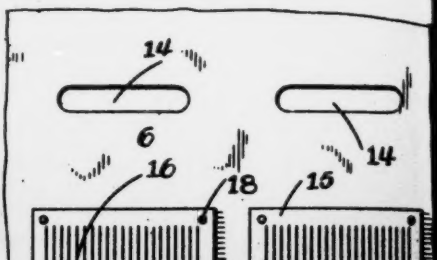

Fig. 7.

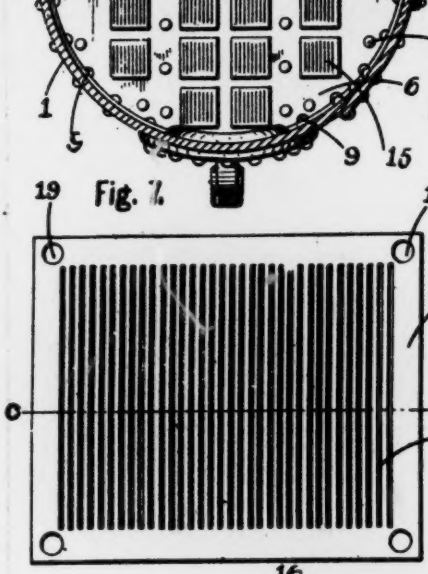

Fig. 8.

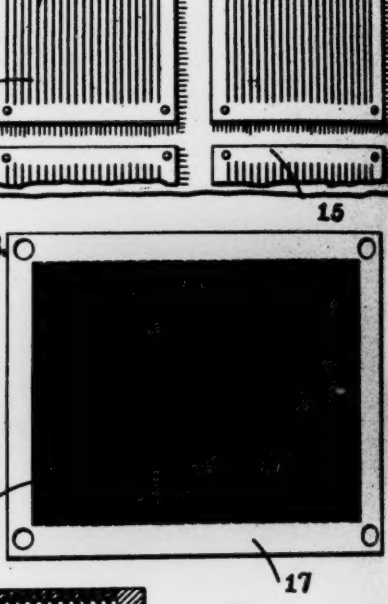

Fig. 9.

Fig. 10.

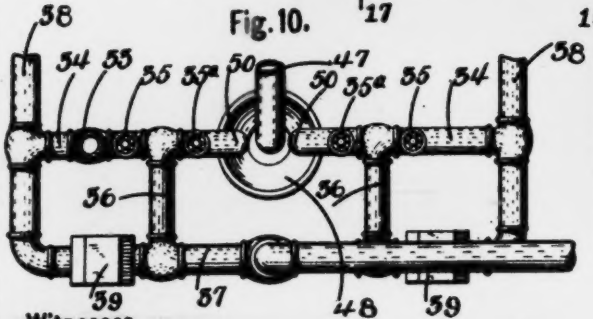

Fig. 11.

Witnesses.

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Inventor.

Frank E. Bachman

By A. J. Saugster.

Attorney.

UNITED STATES PATENT OFFICE.

Frank E. Bachman, of Buffalo, New York.

FILTER.

SPECIFICATION forming part of Letters Patent No. 678,532, dated July 16, 1901.

Application filed October 31, 1900. Serial No. 34,985. (No model.)

To all whom it may concern:

Be it known that I, FRANK E. BACHMAN, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented certain new and useful Improvements in Filters, of which the following is a specification.

My invention relates to an improved filtering apparatus which is principally adapted to be used in connection with the water-purifying plant described and claimed in my companion application, filed March 21, 1900, Serial No. 9,524.

One of the main objects of the invention is to provide the filters with a base-plate of simple and cheap construction upon which the filter-bed is supported, and another object is to connect the filters by a simple arrangement of pipes, so that while one filter is operating the other may be washed and cleaned out.

For a full understanding of the merits and advantages of the invention, reference is to be had to the accompanying drawings and the following description.

The invention is susceptible to various changes in the form, proportion, and minor details of construction without departing from the principle or sacrificing any of the advantages thereof; and to a full disclosure of the invention an adaptation thereof is shown in the accompanying drawings, in which—

Figure 1 represents a side elevation of a pair of filters connected together by a suitable arrangement of pipes. Fig. 2 is a top plan view. Fig. 3 is a vertical central section through one of the filtering-tanks. Fig. 4 is an enlarged detached top view of the perforated cleaning device. Fig. 5 is a horizontal section on or about line *b b*, Fig. 3. Fig. 6 is an enlarged fragmentary top view of a portion of the slotted filter-plate. Fig. 7 is an enlarged top view of one of the strainer-plates. Fig. 8 is an enlarged bottom view of one of the strainer-plates. Fig. 9 is a section through one of the strainer-plates on or about line *c c*, Fig. 7. Fig. 10 is an enlarged fragmentary top plan view of the lower portion of the piping connecting the filters. Fig. 11 is an enlarged fragmentary section through one of the check-valves.

The filtering-tanks are preferably constructed as shown in Figs. 1, 2, and 3, having a cylindrical body 1, a concavo-convex bottom 2, a top 3, an inlet 4 in the top into which the lower end of one of the inlet-pipes 5 extends, a perforated filter-plate 6, arranged horizontally a short distance above the concavo-convex bottom and rigidly riveted or bolted to the horizontal inner portion of the annular angle-iron 7 by the rivets or bolts 8, the angle-iron being riveted or bolted to the interior of the cylindrical body by rivets or bolts 9, and a wash-out or clean-out device is arranged above the filter-plate and rigidly fastened to the inner horizontal portion of an annular angle-iron 10 by the curved rods 11 and lock-nuts 12, the angle-iron 10 being bolted or riveted to the interior of the body by the bolts or rivets 13.

The preferable construction of the filter-plate is shown in Figs. 5, 6, 7, 8, and 9, in which the main circular filter-plate 6 is provided with a series of elongated slots or openings 14, and a plurality of small strainer-plates 15, corresponding in number to the elongated slots, are each detachably fastened on the circular filter-plate over one of the elongated slots. Said strainer-plates are each provided with a series of long narrow parallel openings, which are arranged as shown in the section in Fig. 9, having the top portion 16 extremely narrow in width to prevent the passage of the material of the filter-bed and widening into the larger bottom portion 17.

The strainer-plates 15 are preferably arranged so that their narrow parallel openings extend transversely or at right angles to the elongated slots in the large circular filter-plate, and they are detachably secured in place by bolts 18, which pass through holes 19 in the strainer-plates into the filter-plate to afford convenient means for removing, cleaning, or replacing clogged or defective plates.

The preferable construction of the wash-out or clean-out device is shown in Fig. 4, in which two perforated pipes 20 and 21 are arranged concentrically with each other and are connected together by a cross-pipe 22, which extends diametrically with respect to the circular pipes and is connected to each pipe on either side by tubular connections 23. Another cross-pipe 24, extending at substantially right angles to the cross-pipe 22, is connected at each end to the smaller pipe 20 by tubular connections 25, and a four-way connection 26 is arranged centrally with respect to the concentric circular pipes and connects

the pipes 22 and 24 at their crossing-point. Each of the pipes 20 and 21 is preferably formed in sections or segments, which are connected together by sleeves 27, and the main cross or connecting pipe 22 extends through the side of the filter-body, as will be more specifically described hereinafter. The circular concentric pipes and the cross-pipes are each provided with a plurality of apertures or orifices 28, and the filter is preferably filled with filtering material up to the horizontal dotted line *y* in Fig. 3, the filter-bed being supported upon the circular filter-plate 6.

The filters are preferably arranged in pairs in side-by-side position, as shown in Figs. 1 and 2, and the main cross-pipe 22 of the wash-out device of each filter extends through the side of the filter and into connection with an upper transverse horizontal pipe 29, which in turn connects at or near its middle with a short upwardly-extending vertical pipe 30. Said pipe 30 has an elbow 31 at its upper end, which connects to a pipe 32, leading to a source of water-supply. A vertical pipe 33 extends downwardly from the pipe 29 at one side of the short vertical pipe 30 and connects at its lower end to one of the two lower transverse horizontal pipes 34, each of which is provided with two shut-off cocks 35 and 35^a, and a short horizontal pipe 36 extends from each of the pipes 34 from a point between its cocks 35 and 35^a (see Fig. 10) outwardly into connection with a second lower horizontal pige 37, from which short horizontal pipes 38 extend into the filter-tank below the circular filter-plate 6. The second lower horizontal pipe 37 is provided with check-valves which are arranged to close automatically during the washing out of one of the filters. These check-valves are preferably formed as shown in Fig. 11, in which the pipe 37 is provided with enlargements 39, which each form a box for a swinging leaf 39^a, hung from horizontal pivots 39^b, journaled in the upper portion of the enlargements. The movement of the leaf in one direction is limited by a rib 39^c, extending upward from the interior of the bottom of the pipe. The object of the check-valve is to provide an automatic one-way valve that cannot be closed to prevent the passage of water from the filter, and thus product dangerous pressure in the filter.

A filter provided with the ordinary valve usually employed may be burst by the water-pressure should a careless workman close the valve and neglect to open it. As my improved check-valve is opened automatically by the water-pressure, this danger is entirely obviated.

The pipe 32 is provided with a shut-off cock 40, and the upper horizontal pipe with a cock 41 at each end.

The secondary horizontal pipe 42, having two shut-off cocks 45, connects the short vertical inlet-pipes 5 below a main horizontal pipe 43, which is connected to the main water-supply pipe 44 and has two shut-off cocks 49^a, and a horizontal pipe 46 connects to said pipe 42 at or near the middle thereof and extends forward at substantially right angles and then bends and extends vertically downward in front of the filter, as shown at 47 in Figs. 1, 2, and 10, its lower end being arranged directly above the funnel-mouth 48 of the washout-pipe 49. (See Fig. 1.)

The inner end 50 of the horizontal pipes 34 each bend downward and discharge into the funnel 48. (See Fig. 1.)

With the above construction one of the filters can be cleaned out while the other is in operation, by water direct from a supply-pipe, by opening the cock 40 of the pipe 32, the cock 41 controlling the admittance of water into the clean-out device of the filter requiring cleaning, and opening the cock 45 to permit the cleaning-water to pass from the filter to the waste-pipe and closing the cock 49^a of the filter requiring cleaning, the check-valve in the pipe 37 closing automatically; or both filters can be cleaned at the same time by closing both of the inlet-cocks 49^a and opening the cock 40 and both pairs of cocks 41 and 45. It is found preferable, however, to clean one filter by means of heated water taken directly from the other filter, as the coagulating impurities are more easily removed by hot water. My improved filter is preferably employed in connection with the apparatus shown in my pending application, filed March 21, 1900, Serial No. 9,524, in which the water is heated before reaching the filter. To do this, the cock 49^a is closed, the cock 45 is opened, the cock 35^a, which is for draining only, is closed, and the cock 35, communicating with the operating-filter, is opened sufficiently to permit the proper amount of water to pass from the operating-filter into the filter requiring cleaning and then pass into the waste.

The check-valve in the pipe 37 closes automatically by back pressure of water to prevent the passage of the water into the filter through the pipe 38.

The object of the short pipe 36 is to provide means for the passage of the cleaning-water in the filter, as the water cannot flow back through the pipe 37 owing to the check-valve 39.

The cock 35 is usually left open to the water-passage and is only closed when it is desired to cut one filter off from its companion.

I claim as my invention—

1. A filtering-tank having a granular filtering medium and an inlet and outlet, concentric circular perforated clean-out pipes arranged in the granular filtering medium and near the top surface thereof, and a perforated filter-plate between the clean-out pipes and the outlet having a plurality of detachable strainer-plates.

2. A filtering-tank having a granular filtering medium and an inlet and outlet, concentric circular perforated clean-out pipes arranged in the granular filtering medium and near the top thereof, a filter-plate between the clean-out pipes and the outlet having a plurality of elongated slots and a plurality of strainer-plates corresponding in number to the slots and each arranged upon one of said slots and each having a series of narrow openings extending transversely to the slot, as set forth.

3. A filtering-tank having a granular filtering medium and an inlet and outlet, concentric circular perforated clean-out pipes arranged in the granular filtering medium and near the top thereof a filter-plate between the clean-out pipes and the outlet having a plurality of elongated slots and a plurality of strainer-plates corresponding in number to the slots, and each detachably arranged upon one of said slots, and each having a series of narrow parallel openings extending transversely to the slot, said slots widening from the top downward, as set forth.

4. In combination, two filters, an inlet-pipe connected to the top of each filter and having connection with a source of water-supply, an upper valved connection between said inlets, a waste-outlet, a pipe leading from the valve connection to said waste-outlet, an intermediate pipe having its ends extending through the side of the filters, concentric circular clean-out pipes within the filters connected to the intermediate pipe, an outlet-pipe connected to the lower portion of each filter, a lower valved connection between the outer ends of said outlets, two horizontal pipes each extending from a point between the ends of one of the outlets and having their inner ends emptying into the waste-outlet and short pipes connecting said horizontal pipes to the lower valved connection, as set forth.

5. A filter-tank having a filter-plate provided with slots and a series of strainer-plates having a plurality of narrow openings and each strainer-plate arranged above one of the slots in the filter-plate with its openings crossing said slot.

6. In an apparatus for purifying water, a filter-tank having a filter-plate provided with slots and a series of strainer-plates having a plurality of narrow parallel openings and each strainer-plate arranged above one of the slots in the filter-plate with its openings extending transversely to the slot.

7. A filter having two concentric perforated cleaning-pipes, a straight perforated pipe extending across the inner connectric pipe and a straight perforated pipe crossing both of the concentric circular pipes and the first-mentioned straight pipe.

8. A filter having a cleaning device composed of two circular concentrically-arranged pipes provided with perforations, and straight perforated cross-pipes connecting said circular pipes and arranged at angles to each other.

9. In combination, two filters, an inlet-pipe connected to each filter and having connection to a source of water-supply, an upper valved connection between said inlets, a waste-outlet, a pipe leading from the upper valved connection to said waste-outlet, an intermediate pipe having its ends extending through the sides of the filters, concentric circular clean-out pipes within the filters connected to the intermediate pipe, an outlet-pipe connected to the lower portion of each filter, a lower connection between the outer ends of said outlets, check-valves in said connection operated automatically by back pressure of water, two horizontal pipes each extending from a point between the ends of one of the outlets and having their inner ends emptying into the waste-outlets and short pipes connecting said horizontal pipes to the lower connection, as set forth.

10. In combination, two filters, an inlet-pipe connected to each filter and having connection with a source of water-supply, pipes connecting said filters, and a check-valve in one of said pipes operated automatically by water-pressure to prevent dangerous pressure in the filters, substantially as set forth.

11. In combination, two filters, an inlet-pipe connected to each filter and having connection with a source of water-supply, a plurality of pipes connecting said filters, shut-off cocks in said pipes, and check-valves in one of said pipes closed automatically by exterior pressure and opened automatically by interior pressure of water, substantially as set forth.

12. A filter-tank having a perforated filter-plate and a series of strainer-plates having a plurality of narrow openings; each strainer-plate being arranged above one of the perforations in the filter-plate with its narrow openings crossing said perforations.

FRANK E. BACHMAN.

Witnesses:
W. H. EVERHART,
E. S. CARTER.

No. 707,899 Patented Aug. 26, 1902.

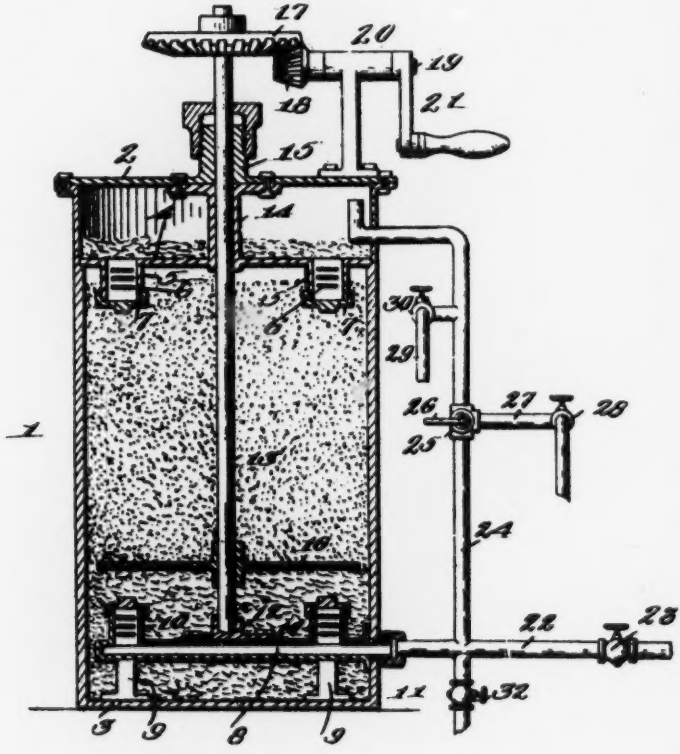
F. BOMMARIUS.

FILTER.

Application filed Dec. 31, 1901.

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.



Witnesses:
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Frederick Bommarius
By
W. H. Cook
Atty.

No. 707,899 Patented Aug. 26, 1902.

F. BOMMARIUS.

FILTER.

Application filed Dec. 31, 1901.

(No Model.) 2 Sheets—Sheet 2

Fig. 2.

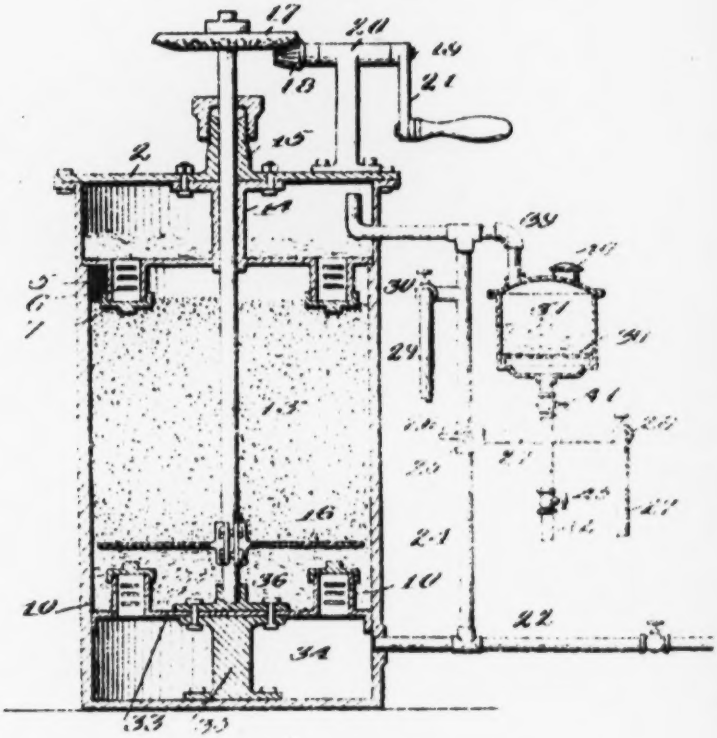


Fig. 3.

Witnesses:

Inventor:

By

UNITED STATES PATENT OFFICE.

Frederick Bommarius, of New Orleans, Louisiana.

FILTER.

SPECIFICATION forming part of Letters Patent No. 707,899, dated August 26, 1902.

Application filed December 31, 1901. Serial No. 87,938. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK BOMMARIUS, a citizen of the United States, residing at New Orleans, in the parish of Orleans and State of Louisiana, have invented new and useful Improvements in Filters, of which the following is a specification.

This invention relates to filters, and is in the nature of an improvement on the filter for which I obtained Letters Patent of the United States on the 29th day of August, 1899, and numbered 632,091.

The present invention has for its object to improve the construction of the filter shown in said Letters Patent and to render its operation more efficient and thorough.

To these ends my invention consists in the features and in the construction, combination, and arrangement of parts hereinafter described, and particularly pointed out in the claims following the description, reference being had to the accompanying drawings, wherein—

Figure 1 is a vertical sectional view of one form of my improved filter that is particularly designed for filters of relatively small capacity. Fig. 2 is a similar view of a slightly-modified construction especially designed for filters of large capacity, and Fig. 3 is a detailed sectional view of the three-way valve employed in both arrangements.

Referring to Fig. 1 of the drawings, the numeral 1 indicates the filter-casing, preferably comprising a cylindrical upright metallic vessel having securely affixed at its upper and lower ends heads, respectively indicated by the numerals 2 and 3. Firmly affixed in the upper portion of the vessel 1 at a suitable distance below the head 2 is a diaphragm 4, having inserted therein a plurality of short tubes 5. Said tubes 5 are preferably formed of brass and are provided with horizontal slits 6. The upper ends of the tubes 5 may be threaded or expanded in suitable perforations formed in the diaphragm 4 and their lower ends are closed by screw plugs or caps 7. In the lower portion of the filter-casing 1 is arranged a horizontally-disposed pipe 8, which is supported on the bottom head 3 by pedestals 9, and fitted in the upper side of said pipe 8 is a plurality of horizontally-slitted tubes 10, constructed in all respects in manner similar to the tubes 5, before referred to. The pipe 8 projects through one side of the filter-casing and is threaded, as at 11. Formed on the upper side of the pipe 8 is a step-bearing 12, in which is stepped the lower end of the vertical shaft 13, and the upper end of said shaft projects through a sleeve 14, which passes through a central perforation formed in the diaphragm 4 and is attached at its upper end to the under side of the head 2. Secured to the upper side of said head, above the upper end of the sleeve, is a stuffing-box 15, through which the upper end of the said shaft projects and in which it is tightly packed. Fixed on the shaft 13 in its lower end are perforated stirrer-arms 16, that project horizontally and radially from said shaft. On the upper end of the shaft 13 is fixed a beveled gear-wheel 17, that gears with the corresponding beveled pinion 18, mounted on a horizontal shaft 19, having a bearing in a suitable bracket-arm 20, secured to the head 2. On the end of the shaft 19 is fixed a crank-handle 21, by means of which rotary movement may be imparted to the stirrer-arms 16, for the purpose hereinafter described. Coupled to the threaded end of the pipe 8, before referred to, is a discharge-pipe 22, provided with a hand-valve 23, and coupled to said pipe and extending vertically therefrom is a pipe 24, which at its upper end projects into the filter-casing at a point between the diaphragm 4 and head 2. Arranged in the pipe 24 is a three-way valve 25, provided with a handle 26, and coupled to the casing of said valve is a water-inlet pipe 27, that may lead from a water-main, reservoir, or any other suitable source of supply, and has arranged in it a hand-valve 28. A waste-pipe 29 is connected at one end to the pipe 24 at a point between the three-way valve and its upper end and is provided with a hand-valve 30. In the space above the diaphragm 4 is deposited a suitable quantity of iron filings, and a suitable quantity of the same material is deposited in the lower end of the filter-casing at a point below the stirrer-arms 16. The body of the filter-casing above the stirrer-arms and up to the under side of the diaphragm 4 is filled with a charge of sand.

The operation of this form of my filter is as follows: The valve 30 in the waste-pipe 29 and a similar valve 32 in the lower end of the pipe 24 are closed. The valve 28 in the inlet-pipe 27 is opened, and the three-way valve 25 is turned to place the pipe 27 and the upper part of the pipe 24 in communication. Water then enters by pipes 27 and 24 into

the upper end of the filter-casing above the diaphragm 4 and first passes through the iron filings and through the slitted tubes 5. It then passes on downward through the bed of sand, and in the lower end of the casing again passes through the bed of iron filings. If the valve 23 be now opened, the water will pass into the slitted tubes 10 and thence by the pipe 8 and the discharge-pipe 22 to the point where it is to be used. Should the filter become foul or in need of cleansing, the valves 23 and 32 are closed. The three-way valve is turned to a position to place the inlet-pipe 27 in communication with the lower end of the pipe 24. The valve 30 in the waste-pipe 29 is then opened, as is also the valve 28 in the inlet-pipe. The water will then flow through the inlet-pipe 27 and the lower end of the pipe 24 into the pipe 22 and from the latter into the pipe 8, from whence it will be discharged in an upward direction through the slitted tubes 10. The water then passes upward through the iron filings and the sand bed in the body of the filter-casing, thence through the slitted tubes 6 into the space between the diaphragm 4 and head 2, and thence out by the pipe 24, and is discharged through the waste-pipe 29. While the water is thus passing in this manner through the filter the crank 29 is turned and through the medium of the gearing described rotates the shaft 13 and the stirrer-arms carried by the latter and stirs up and agitates the filtering material. The water in its upward passage is thus enabled to wash off the impurities from every particle of the filtering material and discharges said impurities through the waste-pipe 29, as before stated. After the filter has been thoroughly cleansed it may be restored to its former position in the manner described and the filtering operation resumed. By arranging the diaphragm 4 in the filter-casing in the manner described the iron filings through which the water is first caused to pass are prevented from working their way down through the sand bed into the bottom of the filter, which they otherwise would do owing to their superior weight. Furthermore, by making the slitted tubes 5 pendent from the diaphragm 4 and by causing the slitted tubes 10 to project vertically upward from the pipe 8 the water during the filtering operation is distributed downwardly through the filtering material from the space above the diaphragm 4, while in the cleansing operation the water is directed by the slitted tubes 10 to flush out the filtering material. I have described the tubes as being horizontally slitted. Said slits, however, may be formed vertically or may consist of round or other suitably-shaped perforations or apertures. I have also described the pipe 8 in the lower portion of the filter-casing as being a straight pipe; but it is obvious that it might be formed in the shape of a coil or a ring or annulus or any other suitable or approved shape without departing from the spirit of the invention.

In the arrangement shown in Fig. 2 of the drawings the construction is in most respects identical with that immediately above described. Those pars shown in Fig. 2 which are constructed and arranged in the same manner as corresponding parts in the arrangement shown in Fig. 1 will be designated by the same reference-numerals.

Referring to Fig. 2 of the drawings, the numeral 1 indicates the filter-casing, closed at its top and bottom by heads respectively indicated by the numerals 2 and 3. Arranged in the upper part of the filter-casing at a suitable distance below the head 2 is a transverse diaphragm 4, pendent from which are slitted tubes 5, closed at their lower ends by plugs or caps 7, said tubes being opened at their upper ends and threaded or expanded into suitable perforations formed in the diaphragm in the manner hereinbefore described. Arranged in the lower portion of the filter-casing is a transverse diaphragm 33, projecting upwardly from which are slitted tubes 10, open at their lower ends and threaded or expanding into suitable perforations formed in said diaphragms, the upper ends of the said tubes being closed by plugs or caps in manner similar to the tubes 5. A space 34 is formed between the lower diaphragm 33 and the bottom head 3 and said space termed a "collecting-chamber," which term may also be used to designate the pipe 8. (Shown in Fig. 1.) Fixed centrally to the bottom of the head 3 is a pedestal 35, which is bolted to the under side of the diaphragm 33 and forms a support to the latter and for the shaft 13, which is stepped in a bearing 36, bolted to the upper side of the diaphragm 33 immediately above the pedestal. Said shaft is provided with horizontal radially-extending perforated stirrer-arms 16 and projects at its upper end through a sleeve 14, fixed centrally in the diaphragm 4 and connected at its upper end to the head 2. The shaft also projects through a stuffing-box 15, fixed on the upper side of the head-tube, and at its upper end is provided with a bevel or gear wheel 17, that gears with a corresponding pinion gear-wheel 18, fixed on the horizontal shaft 19, having a bearing in a bracket 20 and provided at its extremity with a crank-handle 21. Connected with the collecting-chamber 34 is a discharge-pipe 22, provided with a hand-valve 23, and connected with pipe 22 and extending verti-

cally therefrom is a pipe 24, the upper end of which projects into the filter-casing above the diaphragm 4. This pipe 24 for the purpose of distinguishing it from the other pipes is termed the "feed-pipe," and the corresponding pipe 24 in Fig. 1 is likewise designated by the same term. Arranged in the feed-pipe 24 is a three-way valve 25, and connected with the casing of said valve is a service-pipe 27, leading from the water-main or other suitable source of supply. A valve 28 is arranged in the service-pipe and is for the purpose of controlling the passage of water therethrough. The waste-pipe 29 is connected with the feed-pipe 24 at a point above the three-way valve and is provided with a hand-valve 30. Arranged above the lateral branch of the service-pipe 27 and communicating at its lower end with the latter is a reservoir 37, in the lower portion of which is arranged a strainer 38, and disposed in said reservoir and resting on said strainer is a quantity of iron filings. A pipe 39 leads from the upper end of the reservoir and connects with the upper part of the feed-pipe 24. Said reservoir at its upper end is provided with a normally closed charging-inlet 40, into which the iron filings may be introduced, and at its lower end at the point where it connects with the service-pipe is provided with a hand-valve 41. A waste-pipe 42 is pendent from the lateral branch of the service-pipe 27 at a point immediately below the valve 41 and is provided with a hand-valve 43. A quantity of iron filings is disposed in the filter-casing above the diaphragm 4, and, if preferred, a suitable quantity of such filings may be disposed in the lower portion of the filter-casing between the diaphragm 33 and the stirrer-arms 16, the space between said last-named bed of iron filings and the under side of the upper diaphragm 4 being filled with a bed of sand or the like. If the valves 23, 41, 43, and 30 be closed, the three-way valve 25 be turned to place the service-pipe 27 in communication with the upper part of the pipe 24, and the valve 28 be opened, the water will then flow by the service-pipe 27 and the upper part of the feed-pipe 24 into the space in the filter-casing above the diaphragm 4. The water will then filtrate through the iron filings, will pass through the slitted tubes into that portion of the casing below the diaphragm 4, will then filtrate through the bed of sand and through the lower bed of iron filings, will pass through the slitted tubes 10 and into the collecting-chamber 34, from whence it will be conducted by the discharge-pipe 22 and may be withdrawn from the latter as needed for use. When it becomes necessary to flush out the filter to cleanse the filter-beds, the three-way valve 25 is turned to place the service-pipe 27 in communication with the lower branch of the feed-pipe 24, and the valve 30 in the waste-pipe 29 is opened. The water will then pass by the service-pipe 29 and pipes 24 and 22 into the collecting-chamber 34, will thence pass out of the said chamber by the slitted tubes 10, and will pass up through the iron filings and sand and through the slitted tubes 5 into the space above the diaphragm 4, passing through the iron filings contained in said space, and thence out by the upper branch of the feed-pipe 24 and is conducted off by the waste-pipe 29, the arrangement being identically the same as that before described with reference to the arrangement shown in Fig. 1. When, however, it is desirable that the water to be filtered should pass through a greater quantity of iron filings than is contained in the space above the diaphragm 4 before being filtered through the bed of sand, the valve 41 is opened and the three-way valve 25 is then turned so as to shut off all communication between the service-pipe 27 and both branches of the feed-pipe 24. The water will then pass through the service-pipe 27 up through the strainer and the iron filings contained in the reservoir 37, and thence pass by the pipe 39 and upper portion of the pipe 24 into the space above the diaphragm 4, and from thence the filtering operation will proceed in the manner before described. When the reservoir is to be thrown out of operation, the valve 28 may be closed and the valves 41 and 43 opened, whereupon the water contained in the reservoir will drain off by gravity through the waste-pipe 42, after which the valves 41 and 43 are closed, the valve 28 opened, and the three-way valve turned to a position to put the service-pipe 27 in communication with the upper branch of the feed-pipe, whereupon the water will pass on to the filter without passing through the reservoir.

Having described my invention, what I claim is—

1. In a filter, the combination with the filter-casing having an inlet in its upper end and an outlet in its lower end, of a perforated diaphragm fitted in the upper part of the casing below the inlet, slitted tubes fitted at their upper ends in said perforations and closed at their lower ends, a collecting-chamber arranged in the lower end of the casing and connecting with the outlet, slitted tubes projecting upwardly from said collecting-chamber and closed at their upper ends, and filtering-beds arranged respectively above and below the diaphragm in the upper portion of the filter-casing, substantially as described.

2. In a filter, the combination with the filter-casing having an inlet in its upper end and an outlet in its lower end, of a perforated diaphragm fitted in the upper part of the casing below the inlet, slitted tubes fitted at their upper ends in said perforations and closed at their lower ends, a collecting-chamber arranged in the lower end of the casing and connecting with the outlet, slitted tubes projecting upwardly through said collecting-chamber and closed at their upper ends, and means for reversing the passage of the water through the filter, substantially as described.

3. In a filter, the combination with the filter-casing having an inlet in its upper end and an outlet in its lower end, of a perforated diaphragm fitted in the upper part of the casing below the inlet, slitted tubes fitted at their upper ends in said perforations and closed at their lower ends, a collecting-chamber arranged in the lower part of the casing and communicating with the outlet, slitted tubes projecting upwardly from said collecting-chamber and closed at their upper ends, a filter-bed of iron filings arranged in the casing above the upper diaphragm, and a filter-bed of sand arranged in the casing below the upper diaphragm, substantially as described.

4. In a filter, the combination with the filter-casing having an inlet in its upper end, and an outlet in its lower end, of a perforated diaphragm fitted in the upper part of the casing below the inlet, slitted tubes fitted at their upper ends in said perforations and closed at their lower ends, a collecting-chamber arranged in the lower end of the casing and communicating with the outlet, slitted tubes projecting upwardly from said collecting-chamber and closed at their upper ends, filter-beds arranged above and below the diaphragm in the upper portion of the filter-casing, a vertical shaft arranged centrally in the filter-casing and projecting through the top of the latter, perforated stirrer-arms fixed on the lower portion of said shaft above the collecting-chamber, and gearing arranged externally of the casing for rotating said shaft and stirrer-arms, substantially as described.

5. In a filter, the combination with the filter-casing having an inlet in its upper end and an outlet in its lower end, of a perforated diaphragm fitted in the upper part of the casing below the inlet, slitted tubes fitted at their upper ends in said perforations and closed at their lower ends, a collecting-chamber arranged in the lower end of the casing and communicating with the outlet, slitted tubes projecting upwardly from said collecting-chamber and closed at their upper ends, a valved discharge-pipe leading from the outlet, a feed-pipe leading from the discharge-pipe to the inlet, a service-pipe connected with said feed-pipe intermediate the ends of the latter and a three-way valve for diverting the water from the service-pipe to either branch of the feed-pipe, substantially as described.

6. In a filter, the combination with the filter-casing having an inlet in its upper end and an outlet in its lower end, of a perforated diaphragm fitted in the upper part of the casing below the inlet, slitted tubes fitted at their upper ends in said perforations and closed at their lower ends, a collecting-chamber arranged in the lower end of the casing and communicating with the outlet, slitted tubes projecting upwardly from said collecting-chamber and closed at their upper ends, filter-beds arranged respectively above and below the diaphragm in the upper part of the casing, a valved discharge-pipe leading from the outlet, a feed-pipe leading from the discharge-pipe to the inlet, a service-pipe connected with said feed-pipe intermediate the ends of the latter, a three-way valve for diverting the water from the service-pipe to either branch of the feed-pipe, and a valved waste-pipe connected with the feed-pipe above said three-way valve, substantially as described.

7. In a filter, the combination with a filter-casing having an inlet in its upper end and an outlet in its lower end, and a collecting-chamber in its lower end communicating with said outlet, of a valved discharge-pipe leading from the outlet, a feed-pipe connected with one end of said discharge-pipe and at its other end with the upper end of the filter-casing, and provided with a valved waste-pipe, a service-pipe connected with the feed-pipe intermediate the ends of the latter, a three-way valve for diverting the water from the service-pipe to either branch of the feed-pipe or for shutting off the communication between said pipes altogether, a reservoir connected at its lower end by a valved communication with said service-pipe and at its upper end communicating by a pipe with the upper branch of the feed-pipe, a strainer arranged in the lower end of said reservoir, and a bed of iron filings supported on said strainer, substantially as described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

FREDERICK BOMMARIUS.

Witnesses:

JAMES W. KIRCHHOFF,

W. H. COOK.

UNITED STATES PATENT OFFICE.

Robert Gans, of Pankow, Near Berlin, Germany, Assignor to J. D. Riedel Aktiengesellschaft, of Berlin, Germany, a Corporation of Germany.

ALUMINO-SILICATE OR ARTIFICIAL ZEOLITE.

943,535. Specification of Letters Patent. Patented Dec. 14, 1909.

No Drawing. Application filed February 18, 1907. Serial No. 357,997.

REISSUED

To all whom it may concern:

Be it known that I, ROBERT GANS, a subject of the German Emperor, residing at Pankow, near Berlin, Germany, have invented certain new and useful Improvements Relating to Alumino-Silicates or Artificial Zeolites, of which the following is a specification.

Compounds resembling zeolites have been produced by fusing together an alkali or alkali-carbonate and aluminium-silicate. The compounds are of an amorphous pasty nature and form with water gealtinous liquids, while yielding alkali-silicate and alkali-alumino-silicate. Owing to these two properties they are unsuitable for industrial purposes, especially also as they are almost impermeable.

Hydrated alumino-silicates which contain 2, 3, 4, 6 or more molecules of silicic acid to 1 molecule of alumina and 1 molecule of soda (sodium oxid) and are free from the said faults, are obtained by adding to the melts of alumina-silicates with alkali or alkali-carbonate quartz in sufficient quantity to insure, that the whole of the alkali metal will combine with the silicic acid and the alumina. In producing melts with alkali-carbonate this may be recognized by the fact that the molten and cooled mass, when brought in contact with acids, will not yield carbonic acid at all or only in small quantities.

Another criterion showing that the operation has been performed correctly, is that on treating the molten product with water, the zeolites remain behind, not in a pasty or semi-liquid condition, but as a crystalline compact mass.

Instead of pure aluminium-silicates, minerals containing alumina in the shape of silicates or aluminates or alumina may be fused together with the alkali or alkali-carbonates and quartz or minerals rich in quartz. As a matter of course, alkali-silicate may be used instead of alkali or alkali-carbonate for producing the melt. The zeolites thus obtained have sometimes a crystalline, sometimes a granular and sometimes a laminated structure and are therefore highly permeable, that is to say, liquids filter easily even through a thick layer of these zeolites, they have no tendency to form gelatinous or colloid solutions and are therefore very useful for industrial purposes. They exchange their bases very easily and may be converted into other zeolites by washing with saline solutions. If the percentage of alkali or alkali-carbonate in the melt is very much reduced, for instance so that for $2Al_2O_3.9SiO_2$ there are only $2Na_2CO_3$, nephelin or eolite is produced. These silicates are anhydrous, consequently they are unable to exchange their bases and unsuitable for industrial applications.

Among the great number of modifications of the mixture possible for preparing the melt, I will describe two examples. The number is so great, because by varying the quantity of quartz the contents of alkali may also be varied.

1. The following materials may be mixed together and then fused.

Kaolin	3	parts	by	weight
Quartz	6	"	"	"
Sodium carbonate	12	"	"	"

The molecular composition of this melt is as follows:—

$$1Al_2O_3+10SiO_2+10Na_2O$$

The melt is subjected to extraction with water, thereby obtaining a crystalline alumino-silicate, which has the following composition:

SiO_2	=46.0	per cent.
Al_2O_3	=22	" "
Na_2O	=13.6	" "
H_2O	=18.4	" "

The extraction of the melt with water has the effect of removing chiefly alkali-silicates, such as correspond to the formulas:

$$Na_2SiO_3(K_2SiO_3) \text{ to } Na_4SiO_4(K_4SiO_4)$$

2. Or the following materials may be melted after mixing together:

Alumina	2	parts	by	weight
Quartz	12	"	"	"
Sodium carbonate	20	"	"	"

This melt has the same molecular composition and, on being extracted with water, it yields a product equal to that obtained

from the melt according to the first example.

The products obtained by the present process are suitable chiefly for the purification or softening of water, also for the treatment of saccharine juices and molasses, to relieve them of the potash and soda which cause the formation of molasses, in order that larger quantities of sugar may crystallize out of the liquid.

The purification or the softening of water may be effected in a simple manner by filtering the water through a layer of alumino-silicate containing sodium.

The chemical reaction may take place, for example, in the manner indicated by the following equation:

$$2SiO_2.Al_2O_3.Na_2O + CaH_2(CO_3)_2 = 2SiO_2.Al_2O_3.CaO + 2NaHCO_3.$$

Molasses and saccharine juices containing potash are filtered through alumino-silicates containing calcium, in which case the chemical reaction taking place may be expressed, for example, by the following equation:

$$2SiO_2.Al_2O_3.CaO + K_2O = 2SiO_2.Al_2O_3.K_2O + CaO.$$

What I claim is:—

1. The herein described process for the manufacture of zeolites in a crystalline form, which consists in melting together an alumina-compound and an alkali-carbonate with the addition of as much quartz as may be necessary to insure that the whole of the alkali will combine with the silicic acid and the alumina, and subsequently extracting the melt with water.

2. The herein described process for the manufacture of zeolites in a crystalline form, which consists in fusing together alumina-silicate and an alkali-carbonate, with the addition of the quantity of quartz necessary for converting the whole of the alkali into compounds of silica and alumina, and subsequently extracting the melt with water.

In testimony whereof I have set my hand hereunto in the presence of two subscribing witnesses.

ROBERT GANS.

Witnesses:
PAUL SIEDLER,
RUD. AGUST FELDHOFF.

DEFTS. EX. 58.

UNITED STATES PATENT OFFICE.

Robert Gans, of Pankow, Near Berlin, Germany, Assignor to J. D. Riedel Aktiengesellschaft, of Berlin, Germany, a Corporation of Germany.

PROCESS FOR SOFTENING WATER.

960,887. Specification of Letters Patent. Patented June 7, 1910.

No Drawing. Application filed December 16, 1909. Serial No. 583,350.

To all whom it may concern:

Be it known that I, ROBERT GANS, chemist, subject of the German Emperor, residing at Pankow, near Berlin, Germany, have invented a certain new and useful Process for Softening Water, of which the following is a specification.

For softening water two processes are principally employed. One precipitates the lime and the magnesia in the water by the addition of lime and soda, the other by the addition of lime and baryta. Both processes suffer from the disadvantages that in the softening of cold water the precipitation of the lime and of the magnesia does not take place instantaneously, but only after a comparatively long time. It is also impossible to obtain complete softening by one of the said processes. These disadvantages are avoided by the following process, which utilizes the property of zeolites to absorb caustic lime or caustic baryta, and when brought into contact with the bicarbonates and sulfates of lime and of magnesia, to give up to these salts the bases thus absorbed. In this manner carbonates of lime, magnesia or baryta or sulfate of baryta are formed and by the removal of these bodies the hardness of the water disappears. Complete softening may also be obtained by the addition alone of lime to zeolites, whereby the bicarbonates of lime and magnesia are precipitated, if the water so treated be caused to pass through a supplemental filter of sodium-zeolite, which converts also the sulfates, nitrates and chlorids of lime and magnesia into the corresponding sodium salts by exchange of the bases.

It is only necessary to take care, that the filter does not become choked, by frequently stirring up and skimming off the precipitated lime-magnesia- and baryta-salts. It is advantageous also to employ upward filtration, the fine-grained precipitates being washed off out of the filter, after which filtration is performed in a second filter, for which purpose among others a sodium-zeolite filter is particularly suitable. The zeolites of the second or supplemental filter, which by this process are gradually converted into calcium- and magnesium-zeolites, and re-generated from time to time by the addition of solutions of common salt.

In comparison with softening by zeolites alone the present process has the advantage, that it partially employs cheaper reagents in the form of lime, and that it permits of a considerably greater speed of filtration and consequently requires a smaller filtering surface. In comparison with the lime-soda process the present process likewise offers very important advantages. It permits of the use of the cheapest precipitating and re-generating agents, namely caustic lime for hardness due to carbonate, and chlorid of sodium for hardness due to sulfates, in the regeneration of the zeolites. Furthermore the accurate proportioning of the lime in a dissolved form by the so-called lime saturator, as required by the lime-soda process, is dispensed with, as the zeolites possess the hitherto unknown property of adding alkalinity and of giving it up again on contact with bicarbonates. In this case therefore the zeolites undertake the aforesaid proportioning, which otherwise is difficult to carry out on a commercial scale. In the lime-zeolite-process the separation of the lime takes place almost instantaneously in the layer of the zeolite containing the free caustic lime, while in the lime-soda process a comparatively long time is necessary after the addition of the soda for completing the reaction, a circumstance which renders a larger plant (water reservoirs) necessary. The softening of the same quantities of water consequently necessitates according to the present process a far smaller space than according to the known process. Finally complete softening to zero degree is not practicable with the lime-soda process, but may be obtained with the lime-zeolite process.

The effects obtained in the present process by the alkaline earths can be obtained in the filtration of the water also by the continuous addition of the hydroxids and carbonates of alkalies. In this case also the zeolites undertake the accurate proportioning, as they

absorb the alkalinity in a manner similar to that of the alkaline earths and give it up again to the bicarbonates of the water.

Example I: Water of 10 German degrees of hardness,—viz., water containing ten parts by weight of lime and magnesia in 100,000 (one hundred thousand) parts of water of which 9 degrees are caused by bicarbonates and 1 degree by other salts of the earth-alkalies, is mixed with 130 mg. of hydrate of lime and 20 mg. of hydrate of baryta per liter and filtered at once through a comparatively thick layer of sodium zeolite. By this treatment perfect softening is obtained, as the lower layer of the zeolites acts as a supplementary filter and converts the nitrates, chlorids and undecomposed sulfates of lime and magnesia still present into the corresponding sodium salts.

Example II: To the above water of 10 degrees of hardness are added 132 mg. of hydrate of lime and the water is filtered at once through a layer of sodium zeolite, the filtration taking place from the bottom upward. In this filter is completed the conversion of the bicarbonates of the lime and magnesia in the water into carbonates, which, however, when the speed of filtration is high, pass through the layer of zeolite and render the water turbid. To clarify this water it is filtered through a supplemental filter of sodium-zeolite, which at the same time converts the remaining lime- and magnesia-salts into sodium salts. The softening is perfect. The supplemental filter requires frequent rinsing and regeneration by common salt.

Example III: Water of 10 German degrees of hardness receives per liter an addition of 190 milligrams of soda and is immediately, without waiting for the completion of the reaction, filtered off through a layer of sodium zeolite, the speed of filtration being 10 meters and more per hour. Water of 1 to 2 degrees of hardness results. The slime deposited in the zeolite filter is removed by rinsing backward, as soon as it checks the speed of filtration.

The process may obviously be also employed for the removal of iron and manganese from water.

What I claim is:—

1. The process for softening water, which consists in mixing the water with the hydroxid of an alkaline earth and then filtering it through zeolite, substantially as described.

2. The process for softening water, which consists in mixing the water with hydroxid of lime and filtering it through a sodium-zeolite, substantially as described.

3. The process for softening water, which consists in mixing the water with the hydroxid of an alkaline earth, then filtering it through a layer of sodium-zeolite and finally passing it through a supplemental filter of sodium-zeolite, substantially as described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

ROBERT GANS.

Witnesses:
AUGUST NEUMANN,
CORNELIUS MASSACIU.

UNITED STATES PATENT OFFICE.

Robert Gans, of Pankow, Near Berlin, Germany, Assignor to J. D. Riedel, Aktiengesellschaft, of Berlin, Germany, a Corporation of Germany.

HYDRATED ALUMINO-SILICATES, OR ARTIFICIAL ZEOLITES, AND PROCESS OF PRODUCING SAME.

13,688. Specification of Reissued Letters Patent. Reissued Feb. 17, 1914.

No Drawing. Original No. 943,535, dated December 14, 1909. Serial No. 357,997. Application for reissue filed October 13, 1911. Serial No. 654,551.

To all whom it may concern:

Be it known that I, Dr. Robert Gans, a subject of the German Emperor, residing at Pankow, near Berlin, Germany, manufacturing chemist, have invented certain new and useful Hydrated Alumino-Silicates, or Artificial Zeolites, and Process of Producing Same, of which the following is a specification.

Compounds resembling zeolites have been produced by fusing together an alkali or alkali-metal-carbonate and aluminum-silicate. The compounds are of an amorphous pasty nature and form with water gelatinous liquids, while yielding alkali-silicate and alkali-alumino-silicate. Owing to these two properties they are unsuitable for industrial purposes, especially also as they are almost impermeable.

Hydrated alumino-silicates, which contain 2, 3, 4, 6 or more molecules of silicic acid to 1 molecule of alumina and 1 molecule of soda (sodium oxid) and are free from the said faults, are obtained by adding to the melts of alumina-silicates with alkali or alkali-metal-carbonate quartz, in sufficient quantity to insure, that the whole of the alkali metal will combine with the silicic acid and the alumina. In producing melts with alkali-metal-carbonate, this may be recognized by the fact that the molten and cooled mass, when treated with acids, will not yield carbonic acid at all or if at all only in small quantities.

Another criterion showing that the operation has been performed correctly, is that on treating the molten product with water, the zeolites remain behind, not in a pasty or semi-liquid condition, but in a crystal-like or granular condition.

Instead of pure aluminum silicates, minerals containing alumina in the shape of silicates or aluminates or alumina may be fused together with the alkali or alkali metal-carbonates and quartz or minerals rich in quartz. As a matter of course, alkali-silicate may be used instead of alkali or alkali-metal-carbonate for producing the melt. The zeolites thus obtained have a crystal-like or granular form and are therefore highly permeable, that is to say, liquids filter easily, even through a thick layer of these zeolites, they have no tendency to form gelatinous or colloid solutions and are therefore very useful for industrial purposes. They exchange their bases very easily and may be converted into other zeolites by washing them with saline solutions, for example, hard water containing the carbonates and sulfates of lime and magnesia may be used, whereby the zeolites are converted from sodium zeolites into calcium and magnesium zeolites. If the percentage of alkali or alkali-metal-carbonate in the melt is very much reduced nephelin or eolite is produced. These silicates are anhydrous, they have not the capacity for exchange of their bases and are consequently unsuitable for industrial applications.

Among the great number of modifications of the mixture possible for preparing the melt, I will describe two examples. The number is so great, because by varying the quantity of quartz, the contents of alkali may also be varied.

1. The following materials may be mixed together and then fused.

Kaolin	3	parts	by	weight
Quartz	6	"	"	"
Sodium carbonate	12	"	"	"

The molecular composition of this melt is as follows:

$$1Al_2O_3+10SiO_2+10Na_2O.$$

The melt is subjected to extraction with cold water, thereby obtaining an alumino-silicate in a crystal-like or granular form, which has the following composition:

SiO_2	=46.0	per cent.
Al_2O_3	=22.0	" "
Na_2O	=13.6	" "
H_2O	=18.4	" "

The extraction of the melt with water has the effect of removing chiefly alkali-silicates, such as correspond to the formulas:—

$$Na_2SiO_3(K_2SiO_3) \text{ to } Na_4SiO_4(K_4SiO_4)$$

and the extraction with water is continued until no soluble substances remain.

2. Or the following materials may be melted after mixing together:

Alumina.....	2	parts by	weight
Quartz	12	" "	"
Sodium carbonate...	20	" "	"

This melt has the same molecular composition and, on being extracted with cold water until no soluble substances remain, it yields a product equal to that obtained from the melt according to the first example.

The products obtained by the present process are suitable chiefly for the purification or softening of water, also for the treatment of saccharine juices and molasses, to remove the potash and soda which cause the formation of molasses, in order that larger quantities of sugar may crystallize out of the liquid.

The purification or the softening of water may be effected in a simple manner by filtering the water through a layer of zeolites or alumino-silicate containing sodium.

On the saturation of the zeolites with the bases of the salts contained in the hard water, the zeolites may be reconverted or regenerated by filtering through them a solution of a sodium salt, by which a sodium alumino-silicate is again produced.

The chemical reaction may take place, for example, in the manner indicated by the following equation:

$$2SiO_2Al_2O_2\,Na_2O+CaH_2(CO_3)_2= 2SiO_2Al_2O_2CaO+2NaHCO_3.$$

Molasses and saccharine juices containing potash are filtered through alumino-silicates containing calcium, in which case the chemical reaction taking place may be expressed for example, by the following equation:

$$2SiO_2.Al_2O_2CaO+K_2O= 2SiO_2.Al_2O_2.\,K_2O+CaO.$$

What I claim as my invention and desire to secure by Letters Patent is:—

1. The herein described process for the manufacture of zeolites in a crystal-like or granular form, which consists in melting together one part of alumina by weight with from seven to ten parts by weight of an alkali with the addition of as much quartz as may be necessary to insure that the whole of the alkali metal will combine with the silicic acid and the alumina, and subsequently extracting the melt with water.

2. The herein described process for the manufacture of zeolites in a crystal-like or granular form, which consists in fusing together sufficient quantity of alumina-silicate to furnish one part by weight of alumina with from seven to ten parts by weight of an alkali with the addition of the quantity of quartz necessary for converting the whole of the alkali metal into compounds of silica and alumina, and subsequently extracting the melt with water.

3. The herein described process for the manufacture of zeolites in a crystal-like or granular form, which consists in melting together one part by weight of alumina with from seven to ten parts by weight of an alkali-carbonate with the addition of as much quartz as may be necessary to insure that the whole of the alkali metal will combine with the silicic acid and the alumina, and subsequently extracting the melt with water.

4. The herein described process for the manufacture of zeolites in a crystal-like or granular form, which consists in fusing together sufficient quantity of alumina-silicate to furnish one part by weight of alumina with from seven to ten parts by weight of an alkali-carbonate with the addition of the quantity of quartz necessary for converting the whole of the alkali metal into compounds of silica and alumina and subsequently extracting the melt with water.

5. A new article of manufacture, fused and hydrated alumino-silicates in a crystal-like or granular form, substantially as described.

In testimony whereof I have hereunto signed my name to this specification in the presence of two subscribing witnesses.

DR. ROBERT GANS.

Witnesses:

CORNELIUS MASSACIU,

GEORG SEITTGE.

640

T. R. DUGGAN.

METHOD OF AND APPARATUS FOR SOFTENING WATER.

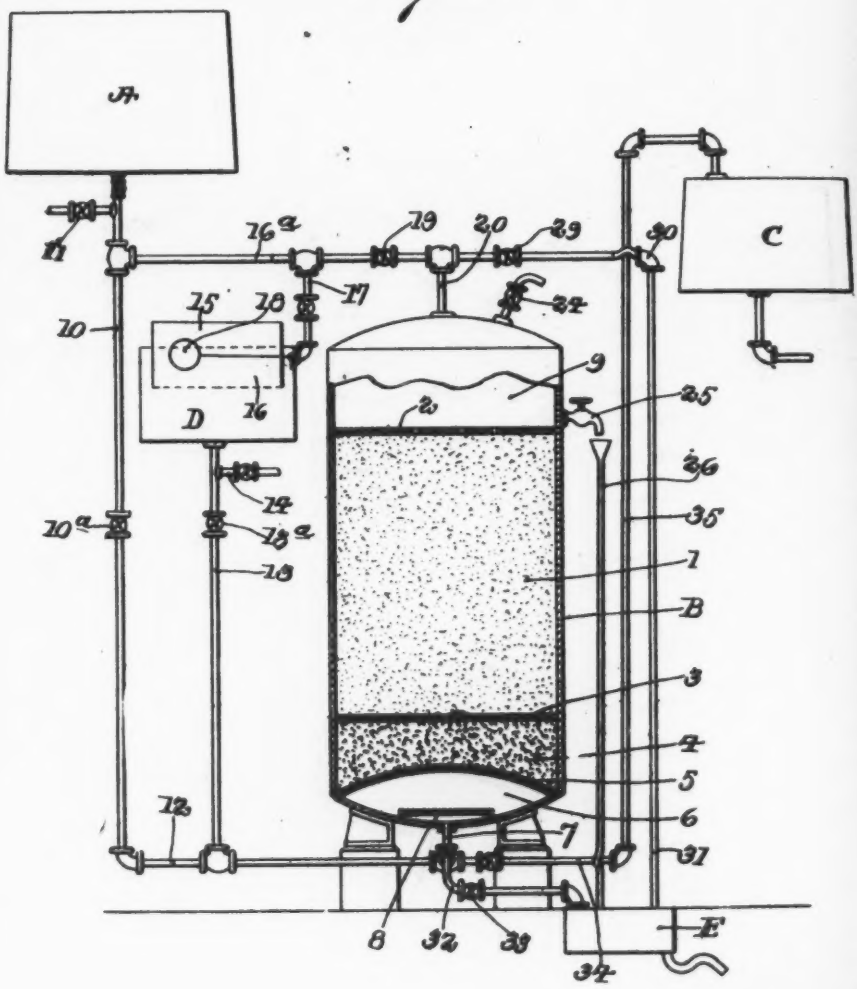
APPLICATION FILED OCT. 23, 1916.

1,276,629.

Patented Aug. 20, 1918.

2 SHEETS—SHEET 2.

Fig. 2.



Witnesses:
George G. McDaniel
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Inventor:
Thomas R. Duggan

By
K. P. McElroy
Attorney

UNITED STATES PATENT OFFICE.

Thomas R. Duggan, of New York, N. Y., Assignor to the Permutit Company, of New York, N. Y., a Corporation of Delaware.

METHOD OF AND APPARATUS FOR SOFTENING WATER.

1,276,629. Specification of Letters Patent. Patented Aug. 20, 1918.

Application filed October 23, 1916. Serial No. 127,127.

To all whom it may concern:

Be it known that I, THOMAS R. DUGGAN, a citizen of Great Britain, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvement in Methods of and Apparatus for Softening Water, of which the following is a specification.

This invention relates to methods of and apparatus for softening water; and it comprises a method of utilizing the activity of exchange silicates to a greater extent than is now the case and of quickly revivifying the same with good utilization of revivifying solutions; and it also comprises certain apparatus with connections adapted for the performance of this method; all as more fully hereinafter set forth and as claimed.

In the method of softening water by the use of exchange silicates which is now well known, water to be softened is passed through certain materials containing silica and alumina (or another amphoteric oxid, such as titanium oxid, iron oxid, chromium oxid, tin oxid, zinc oxid, etc.), alkali and water. These materials are used in the form of small hard granules which are employed as a granular bed.

On the passage of hard water through the bed of granules the lime and magnesia compounds, to which the water owes its hardness, are taken up by the exchange silicate, alkali compounds going into solution in their lieu. After a period of use when the exchange silicate has taken up a certain amount of lime and magnesia, it is revivified by passing a solution of sodium chlorid (common salt) through the bed. The lime and magnesia now go into solution as calcium and magnesium chlorids and the exchange silicate takes up alkali again so that it is ready for re-use.

In large measure, the amount of exchange action which is possible depends upon the operative amount of surface offered to the water flowing through a bed or mass of granules. The water tends more or less to follow channels; and in so doing, of course, certain surfaces are more exposed to water than others and the time of operativeness, that is, the time before regeneration is necessary, depends upon the time of operation of the more exposed faces. The channeling difficulties are more accentuated where the flow of water to be softened is down through the bed than where the flow is upward.

The considerations which apply to the direction of flow of the water to be softened through the bed apply also to the flow of salt solution in regeneration; there is the same tendency to channeling and preferential passage at one point rather than at another.

Ordinarily, the water to be softened is passed through the bed in a downward direction and the salt solution in revivifying is also passed downward. In so doing, the flow of the liquid and gravitation coöperate to keep the granules in place; and the result is that, to a greater or less extent, the described preferential passage of water or liquid at some points rather than at others is favored. In the case of any given group of granules, the flow is apt to be greater past some granules and some granule surfaces, than past others.

An upward passage of water in the softening phase of the apparatus avoids in large measure these difficulties, giving a greater period of activity since the buoying action of the current keeps the granules apart and prevents packing and channeling, but this sometimes brings new difficulties; and particularly where the water is cold and the filter warm or where the exchange silicate is light and bulky. On warming up, the water is apt to liberate air bubbles which cling to the granules and tend to lift them. The tendency to lift is of course less with the denser varieties of silicates, but these do not give as much active surface as the lighter. With light granules, bad design of apparatus, and water which warms up materially in going through the apparatus there may be a relatively serious loss of silicates due to flotation and exit of granules with the softened water. Whatever be the direction of flow of water in the softening phase, however, I find certain advantages are gained by an upward flow of salt solution in the

regenerating phase. With the relatively heavy salt solution passing in an upward direction the relative movement of the granules with regard to each other is more pronounced than it is with a similar flow of water; and uniform passage of the salt solution takes place.

In revivification, it is found that the main part of the absorbed bases will be removed by the salt solution after the regenerating liquid has been supplied to and passed through the layer in an amount equal to or larger than that amount of liquid which can be stored in the spaces between the granules. Or, in other words, the liquid occurring between the granules must be displaced once or twice by the salt solution in order to remove the main part of the bases absorbed by the exchange silicate. Repassage of the used salt solution through the bed does little good and may do harm, since such a solution will only take up a certain amount of calcium or magnesium before losing regenerating power. When in softening the water flows downward and the salt solution passes upward, the lower layers of silicates are completely revived first and it is inexpedient to bring back contaminated brine into contact therewith again. It is desirable in regeneration to bring the clean or uncontaminated salt solution first into contact with the most active or least contaminated layers of silicates.

After the revivifying solution has been used on the exchange silicate, such solution must, as already stated, be removed to prevent the contamination of the water next to be treated. In one way, giving a good utilization of the salt solution, I can gradually admit fresh water at the bottom of the mass, drawing off from a point above; the admission of water being finally stopped and the residual liquid in the bed then removed by draining from the bottom. It is advantageous to choose the amount of water in which the regenerating salt is dissolved, so that the main part of the absorbed basis is taken into solution and taken away before fresh water is introduced. Other ways of removing the salt solution than that indicated may be used; but the described way is economical and practical, since the whole amount of regenerating liquid is well utilized; but any other suitable way may be used. Care should however be taken that repassage of contaminated salt solution through the revived or partially revived bed is avoided.

In the accompanying illustration I have shown, more or less diagrammatically, certain embodiments of apparatus within the present invention and susceptible of use in the described process. In this showing,

Figure 1 is a view, partly in elevation and partly in vertical section, of a type of apparatus in which both the water to be softened and the revivifying solution pass through the silicate bed in an upward direction; and

Fig. 2 is a similar view of a modified structure wherein the flow of water to be softened is normally downward while that of the regenerating solution is, as before, upward. In both figures like reference characters define like parts.

In the structure of Fig. 1, element A, is a tank, pipe or other source of water to be softened and treated, while D is a tank, pipe or other source of salt solution. As shown in Fig. 1, A is a tank. B is a casing for containing the bed of exchange silicates and C is a pipe, tank or other arrangement for removing or receiving softened water. E is a diagrammatically shown sewer connection.

In Fig. 1 casing B contains a layer or bed 1 of exchange silicates. As shown, this layer is kept in position by an upper perforated cross-plate 2 and a lower perforated cross-plate 3, although the use of these plates is not necessary. Below the lower cross-plate is a layer 4 of gravel or the like. The granular silicates may rest directly on this gravel layer instead of being separated therefrom by the plate. And the gravel layer may be dispensed with. Below this layer is another cross-plate 5, which may be replaced by a strainer system or any other suitable structure. Below this cross-plate is open chamber 6 with pipe connection 7 at its lowest point. Baffle 8 is arranged above this pipe connection in order to give an even distribution of the liquid. Above the upper cross-plate is an empty chamber 9. Leading from tank A is water pipe 10 provided with valve 10^a. Valved inlet 11 may be used in lieu of tank A as a source of water to be softened. This pipe 10 extends downwardly to a cross-connection 12 communicating with the casing B at the lowest point. Leading from this cross-connection is another valved pipe 13 leading to tank D for salt solution. In lieu of tank D, salt solution may be brought from another source through valved inlet 14. As shown, tank D is provided with a salt box 15 having

perforated bottom 16. Also leading from the water supply pipe is another cross pipe 16^a provided with valved outlet pipe 17 leading to the tank D for salt solution. As shown, this pipe is also provided with a float valve 18. Beyond this valved outlet pipe (17) in the upper cross pipe is valve 19 and beyond this again is a down pipe 20 leading into the top of casing B. The upper cross pipe beyond this down pipe is prolonged to enter soft water pipe 21. As shown, this soft water pipe has valves 22 and 23, located respectively on each side of the point of inlet of the upper cross pipe. Beyond the lower valve 23 the pipe is prolonged downwardly to the sewer connection E. On the top of the casing B is a valved outlet connection 24 and just above the upper cross-plate is valved waste outlet 25 ending above open pipe 26 which also leads to the sewer connection. The lowermost cross pipe (12) beyond the point of connection with the bottom of the casing B is valved at 27 and has a connection 28 leading to the sewer connection E.

In the structure shown in Fig. 2 the upper cross-pipe is provided with a valve 29 beyond which it extends to special connection 30 and 31 leading down to the sewer connection E. The lower cross pipe (12) has the same connection entering the bottom of the casing B but at this point it has another connection 32 leading past valve 33 to the sewer connection E. Another valved connection 34 leads through pipe 35 to tank C for softened water.

In the use of the structure of Fig. 1, the exchange silicate 1, being supposed to be revived and in condition to soften hard water, such hard water is led in from pipe 11 or tank A and passes through 10 and 12 to 7 whence it passes upward through the layer of gravel or sand and the layer of exchange silicates to 20 and thence through 21, valve 22 being open, to tank C, whence it goes to a place of use. After a time the activity of the exchange silicate 1 will be lessened and it will be necessary to revive. At this time valve 10^a is closed and the valve in 17 is opened, box 15 being supplied with the requisite amount of salt. An amount of water controlled by float valve 18 enters D and dissolves the salt in the salt box. Brine from another source may of course be supplied through pipe 14. The salt solution passes downward through 13 and enters the bottom of the casing B at 7 thence flowing upward to exit at 25, displacing the water before it as it goes and revivifying the exchange silicate. When the amount of salt solution desirable has been passed through, valve 13^a in pipe 13 is closed and 10^a opened. Water flows through 10, 12 and 7 entering the casing at its lowest point and flowing upward to 25, displacing and removing the salt solution as it goes. This passage of water in this direction may be continued until all the salt solution has been displaced. Or valve 24 may be opened to allow air to enter, valve 10^a closed and valve 27 opened allowing the liquid in the bed to flow downward through the mass and go to exit at 7 and 28. It will be noted that 7 communicates with B at the lowest portion of the casing so as to insure a positive draining with removal of all water containing salt. If desired, the valve 24 being closed, 19 may be opened and a supply of fresh water sent through the mass downwardly for washing purposes. The exchange silicate being now revived and washed is ready for another water softening phase as before. In the water softening operation the lower body of sand or gravel 4 and the perforated plates 3 and 5 catch most of the mechanical impurities and the final downward washing to get rid of the salt solution also serves for back washing. Mechanical impurities go out through 7 and 28 to the sewer.

In the operation of the structure of Fig. 2, the flow of the water to be softened is normally downward, while that of the regenerating solution is, as before, upward. In the operation of this structure, presuming the exchange silicate to be regenerated and ready for operation, water from 11 or A passes through 16^a and 20, valve 19 being open, into chamber 9, and thence through the silicate bed 1 downward to 7. From 7 the softened water passes through 34 and 35 to C. When the exchange silicate needs regeneration, the flow of water through the apparatus is stopped and salt solution prepared in D (or supplied from 14) as before. This salt solution passes downward through 13 (valves 10^a and 19 being closed) and into the bottom of the casing B through 7. The salt solution passes upward through silicates 1 to 25 and thence through 26 to waste as before.

In flushing with either form of apparatus shown, wash water may of course be sent through the salt line shown coming through line 16^a and pipe 17 past valve 18 into D and thence downwardly through 13, past valve

13a into the bottom of the casing B through pipe 7. In so doing, a simple manner of operation is afforded since the necessary quantity of salt may be put into box 15 and then the water allowed to flow. The water at first forms the strong salt solution necessary for reviving and then passes this salt solution upwardly through the silicates to waste at 25 and then washes the whole apparatus.

In the operation of the structure of Fig. 1, the salt solution and the water pass through the mass in the same direction; while in the operation of the structure of Fig. 2, the flow of the water to be purified and that of the regenerating salt solution, are in opposed directions. With an upward passage of both liquids as shown in Fig. 1, the advantages of a buoying action during softening as well as during regeneration, are secured; while in the case of Fig. 2, the advantage described due to the entry of the two liquids at opposite faces of the mass of exchange silicate is secured together with a buoying action during regeneration only. Which of the advantages mentioned or of their combinations affords the most economical and most practical operation depends upon prevailing conditions.

With an operation such as that of Fig. 2, the dissolved impurities in the water to which it owes its hardness (lime or magnesia or both) mainly accumulate in the face of the bed at which the water enters (in this case, the top face. On now passing salt solution through from the opposite face, this salt solution, which is of course substantially free of lime and magnesia, passes first through the little contaminated portion of the bed and then into contact with the contaminated portion, there taking up the lime and magnesia. As the flow continues, the dissolving lime and magnesia are carried away from the bed and do not reenter it.

What I claim is:—

1. The process of regenerating after use a bed of water softening exchange silicates containing lime or magnesia, which comprises passing a salt solution through said bed in an upward direction as long as said salt solution continues to dissolve and remove substantial amounts of lime or magnesia, and drawing off the contaminated solution after a single passage through the bed.

2. The process of regenerating after use a bed of water softening exchange silicates containing lime or magnesia, which comprises passing a salt solution through said bed in an upward direction as long as said salt solution continues to dissolve and remove substantial amounts of lime or magnesia, and drawing off the contaminated solution at or near the surface of the bed after a single passage through the bed.

3. The process of regenerating after use a bed of water softening exchange silicates containing lime or magnesia, which comprises passing a salt solution through said bed in an upward direction, drawing off the contaminated solution after a single passage through the bed, such drawing off being continued until the solution has substantially ceased to remove lime or magnesia, and then flushing out the residue of the solution.

4. The process of regenerating after use a bed of water softening exchange silicates containing lime or magnesia, which comprises passing a salt solution through the bed in an upward direction, drawing off the contaminated solution at or near the surface of the bed after a single passage through the bed, such drawing off being continued until the solution has substantially ceased to remove lime or magnesia, and then flushing out the residue of the solution.

5. The process of regenerating after use a bed of water softening exchange silicates, through which the water to be softened has passed downwardly, which comprises passing a salt solution through the bed in an upward direction and drawing off the contaminated solution after a single passage through the bed.

6. The process of regenerating after use a bed of water softening exchange silicates through which the water to be softened has passed downwardly, which comprises passing a salt solution through the bed in an upward direction, drawing off the contaminated solution after a single passage through the bed such drawing off being continued until the solution has substantially ceased to remove lime or magnesia, and then flushing out the residue of the solution.

7. The process of regenerating after use a bed of water softening exchange silicates through which the water to be softened has passed downwardly, which comprises passing a salt solution through the bed in an upward direction, drawing off the contaminated solution at or near the surface of the bed after a single passage through the bed, such drawing off being continued until the

solution has substantially ceased to remove lime or magnesia, and then flushing out the residue of the solution.

8. The process of regenerating after use a bed of water softening exchange silicates, which comprises passing salt solution through the bed in a direction opposite to that in which the water flowed through the bed during softening, whereby the active salt solution contacts first with the least contaminated portion of the bed, and drawing off the contaminated solution after a single passage through the bed, so that contaminated salt solution does not contact with relatively uncontaminated portions of said bed.

9. The process of regenerating after use a bed of water softening exchange silicates, which comprises passing salt solution through the bed in a direction opposite to that in which the water flowed during use, drawing off the contaminated solution after a single passage through the bed, such drawing off being continued until such solution has substantially ceased to remove lime or magnesia, and then flushing out the residue of the solution.

10. In the purification and softening of water, the process which comprises transmitting water downwardly through a granular bed of exchange silicates until such silicates have functioned to a sufficient degree, thereupon passing salt solution followed by wash water through such bed in an upward direction with removal of salt solution and wash water at or above the upper face of such bed until the silicates are regenerated, interrupting the flow at this time and draining the bed from the lowest point, and once more passing water to be softened through the bed in a downward direction.

11. In a water softening apparatus a casing, a bed of granular exchange silicates therein, means for passing water to be softened through such bed and means connected to such casing for passing salt solution therethrough upwardly with means above such bed for removing the salt solution, and means for passing water following after and displacing such salt solution to the point of removal of the salt solution, such means being connected so as to remove substantially all the solution from the casing.

12. In a water softening apparatus, a casing, a bed of exchange silicates therein, means for transmitting water to be softened through such bed and means for passing salt solution through the bed upwardly to a point of outlet above such bed, means for washing out the salt solution and means connected to the lowest point of the casing leading to a place of disposition for removing the water used in such washing out.

In testimony whereof I affix my signture.

THO. R. DUGGAN.

634 DEFT'S. EX. 48

British Patent No. 3870.—Feb. 15, A. D. 1911.

Complete Specification.

Improvements in and relating to the Softening of Water.

I, William Edward Evans, of 27, Chancery Lane, London, W.C., Consulting Engineer, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to apparatus for softening water by the use of zeolites or hydrated alumino-silicates.

The accompanying drawing illustrates diagrammatically, a filter provided according to the invention for softening water.

In carrying the invention into effect, as illustrated in the accompanying drawing a vertical cylindrical casing *a* is provided, closed at the top by a cover plate *b*, and within this casing a number of horizontally disposed perforated plates, such as *c* and *d*, are suitably mounted.

The perforated plate *c* carries a layer or layers of quartz or sand, through which the water to be softened may be first filtered, while the perforated plate *d* carries a layer of hard coarse grained zeolites *f*, through which the water then passes, the layer of zeolites advantageously having a layer *g* beneath, of quartz or sand.

The water to be softened passes from the supply pipe *k* through the inlet valve *m* and inlet pipe *l* to the filter, passing down the filter layer *e* thence through the layer of zeolites or alumino-silicates *f*, and the layer of sand or quartz *g*, to the water-collecting chamber *h* whence it passes through the conical perforated screen *i*, through the outlet pipe *j* and outlet valve *n*.

In operation, the inlet valve *m* for the water to be softened, as well as the outlet valve *n*, are opened, and the water then caused to pass through the filter, and to be completely softened thereby.

After the softening property of the zeolites has been exhausted or reduced, which can be readily ascertained by testing the water passed through, the inlet valve *m* and outlet valve *n* are closed, and a solution of a sodium salt, such as common salt, is passed through the filter by opening the inlet

valve *o*, and allowing the solution of salt, after passing through the filter, to pass outwardly through the waste valve *p*.

By such means it will be understood that the passage of water through the filter may be cut off or diverted, and the regenerating solution may then be passed through, so that the zeolites may be regenerated, and thus the filter is capable of continuous use without the removal of the zeolites from the filter or their renewal.

It is obvious, as a matter of practical convenience that two such filters may be provided, so that one may be used while the zeolites are regenerated in the other, and thus an uninterrupted supply of soft water provided.

Means may be provided for stirring the zeolites, which conveniently may consist of a plate mounted in the casing *a*, so as to be capable of rotation by means of a series of bevel teeth carried by the plate, and pinions gearing therewith, and operable from outside the filter casing. The plate may advantageously have secured to it, a series of rods passing into the zeolites, so that on rotation of the plate, the zeolites are stirred.

The respective layers of filtering material and zeolites may be contained within perforated or other similar removable casings, let into the filter casing *a*, so that the removal of the filtering material and zeolites, from the filter casing, may be facilitated when such is at any time required.

I employ zeolites or alumino-silicates produced according to the process the subject matter of my Application No. 3871 of 1911.

It will be understood that I make no claim broadly to the use of zeolites as filtering media nor yet to the use of salt solutions for regeneration of zeolites nor to the process of purifying water disclosed in the Specification of the prior Patent No. 26,842 of 1909.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. A filtering apparatus for the softening of hard water, consisting of a casing carrying a filter bed of hard crystalline zeolites or hydrated alumino-silicates, means for admitting the water to be softened for passage through the filter casing and for cutting off the supply of water therethrough on the exhaustion of the zeolites and means for passing through the filter casing the supply of a solution of a salt capable of regen-

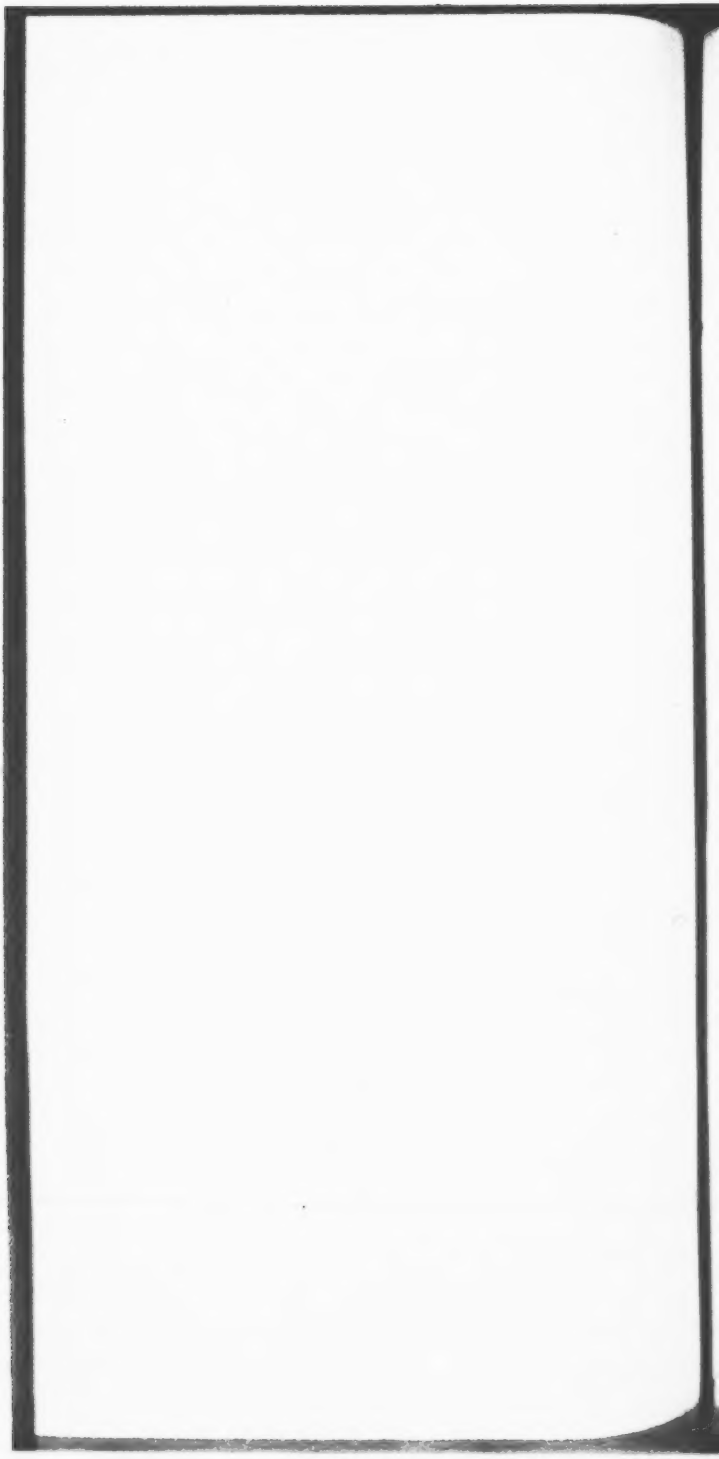
erating the zeolites and for cutting off the supply of said solution, substantially as described.

2. Water softening apparatus substantially as described and illustrated.

Dated this 27th day of July, 1911.

EDWARD EVANS & Co.,
27, Chancery Lane, London, W.C.,
Agents for the Applicant.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1912.



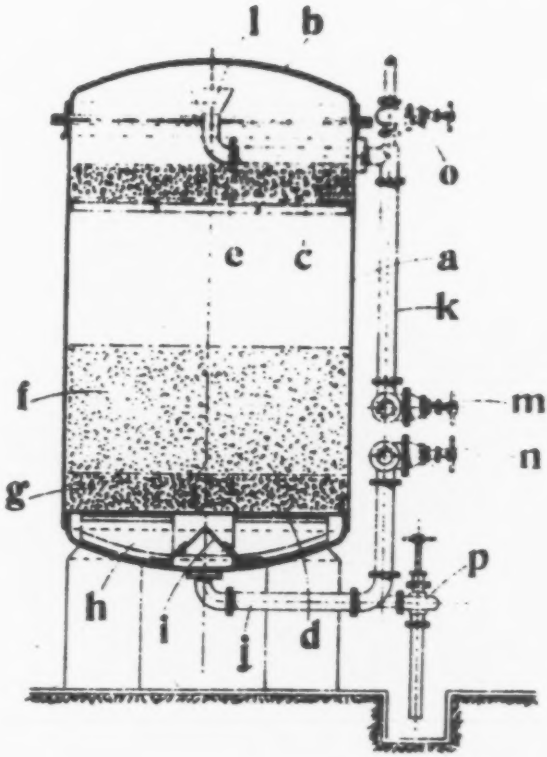


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Fig. 1.

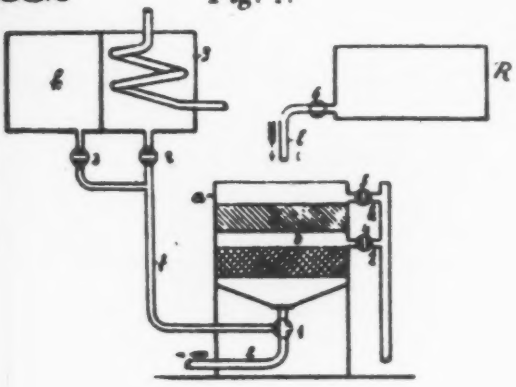


Fig. 4.

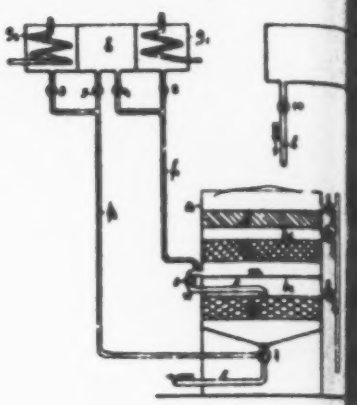


Fig. 2.

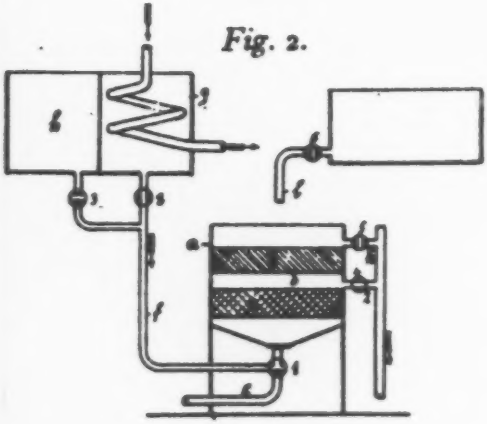


Fig. 5.

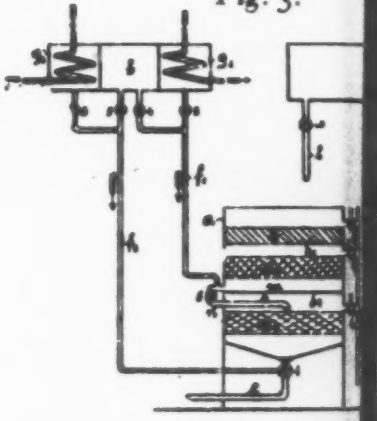


Fig. 3.

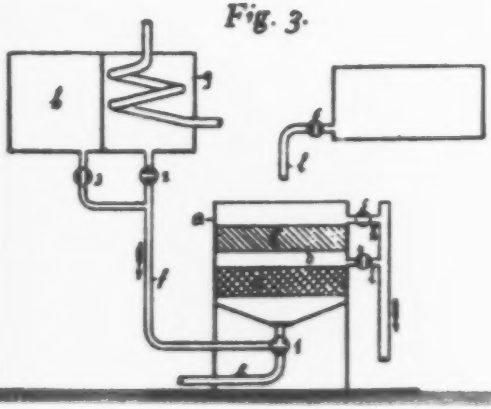
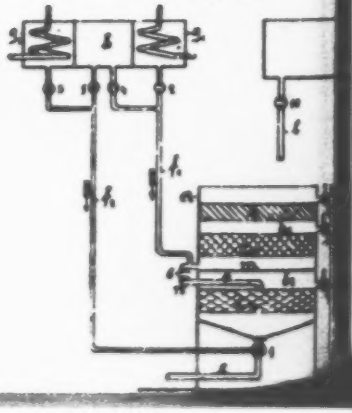


Fig. 6.



605 DEFENDANT'S EXHIBIT 35.

Imperial Patent Office Patent Specification

No. 211,064

Class 12*c*—Group 10

Hans Leister of Darmstadt

Filter apparatus consisting of several superposed filter layers arranged in a casing separated from each other by spaces and provided with special inflow respectively outflow cells for each filter layer connected to common discharge— and wash-water conduits.

Patented in the German Empire, Beginning from January 23, 1908.

The permutits, *i. e.* the so-called artificial zeolites are, as is well known (See German Patent 197111) in a very considerable degree suited for the purification of water which is used and other liquids containing salts in solution. Up to the present, however, there has been a lack of an apparatus which makes possible, in an unobjectionable manner, the useful application, on a large or small scale, of the useful properties of permutits as described above in the purification of water, or the like. This defect is overcome by the present invention, which has for its object an apparatus operating perfectly in every way for the utilization of the permutits for the above said purpose.

The novelty of the apparatus consists in this that in the casing of the apparatus a mechanical filter, and a chemical filter formed by permutits, are arranged one above the other, a so-called flow-off cell being interposed, and the casing of the apparatus is so connected with a container for regenerating liquid and another container for clean water for back washing that by the admission of a regenerating liquid toward the filter casing in a direction opposite to the direction of filtration the chemical filter is regenerated while at the same time the mechanical filter is out of operation, while by the admission of clear water toward the filter casing, and this also
606 in a direction opposite to the direction of filtration, a washing of the mechanical as well as of the chemical filter is effected.

By the construction of the filter apparatus in the said manner the first result is that the elimination of the mechanical impurities contained in the liquid to be purified occurs in a separate space from the elimination of the chemical impurities from the said liquid. Because of this operation in separate spaces, the filtration is effected much more rapidly and more perfectly, for the chemical filter formed by permutits is traversed by a liquid which does not contain any more mechanical impurities, but only chemical ones which by the said chemical filter are completely eliminated in the shortest time. The purified solution leaving the chemical filter or the filter apparatus can, therefore, be conducted directly to the place where it is used or to a collecting tank. The formation of slime by the separation of salts from the purified solution due to the occurrence of a subsequent reaction is impossible.

The above mentioned separation as to space offers the additional advantage that the present filter can remain in operation without any attention for a long period, about five to six days, for a coating of the permutits by mechanical impurities entering the chemical filter and a harmful influence on its operative capacity caused thereby is impossible, because all mechanical impurities are retained by the mechanical filter. After that period a short regeneration of the chemical filter and a subsequent cleaning of the chemical as well as of the mechanical filter are sufficient to render the apparatus again completely operative.

Moreover, by the above mentioned construction of the present filter it is possible to build into an apparatus two superposed filter bodies of an entirely different kind and that, in spite of this, the regeneration of the chemical filter can be effected separately and independently of the cleaning of the two filter bodies.

In the drawing, the filter apparatus according to this invention is shown, by way of example, in two embodiments and purely diagrammatically.

Figs. 1 to 3 show a single and Figs. 4 to 6 a double filter apparatus in various positions of operation.

In the figures 1 to 3, the filter apparatus proper consists of the mechanical filter *b* and the chemical filter *c* 607 built into one and the same casing *a* and between which filters is provided a flow-off cell *d*.

To the bottom of the filter-casing which bottom is advantageously and in well-known manner conically shaped, and outlet *e* for the purified solution is connected, while by means of the three-way valve 1, the pipe *f*, and the valves 2 and 3

can be connected with the regenerating vessel *g*, or with the back-wash container *h*.

The flow-off cell *d* as well as the space above the filter *b* can be connected by the discharge pipes *i* and *k* and the valves 4 and 5 with a conduit leading to the discharge channel.

Fig. 1 shows the position of the valves 1, 2, 3, 4, 5 and 6 during the operation of filtration. Through the open valve 6 and the pipe 1 the solution to be purified passes from the tank R first to the mechanical filter *b*, is freed here from its suspensions, passes then through the flow-off cell *d* and flows through the chemical filter *c*, in which the desired treatment is effected. From there, the purified solution can be conducted direct to the place of use or to a collecting tank. The formation of slime because of any possible separation of salts from the purified solution due to a subsequent reaction does not take place as was the case in the heretofore used apparatuses intended for the same purpose. Regarding the separation of salts dissolved for instance, in water, it may be stated that in all heretofore known apparatuses having for their purpose the treatment of water to be used, at least a daily, if not semi-daily charge with chemicals (mostly lime, soda) is absolutely required. The doses of these chemicals to be added are usually automatically controlled in the said apparatuses. If, however, a change occurs in the raw water, *i. e.* an increase in the soluble salts causing the hardness, the automatic control even of the addition of chemicals will no longer fulfill its purpose.

This is impossible in the present apparatus, for the strength of the chemical filter body is so selected that contrary to the said apparatuses firstly an addition of chemicals for the treatment of the water is altogether unnecessary and secondly, a sudden increase in the hardening salts in the raw water has never any influence on the result of the purification, *i. e.* the formation of boiler scale.

The construction of the present apparatus, as compared with the known purifiers, enables it as has already been stated to be in continued operation 5 to 6 days without any attention and only then a short regeneration of the chemical filter and a cleaning of the chemical and mechanical filter by the general back-washing operation are required.

608

Regeneration is accomplished in the following manner.

The various valves are placed in the position illustrated in Fig. 2. The feed-valve 6 is first closed, the filter is allowed to drain empty, valve 2 is opened and after opening the discharge valve 4, the three-way valve 1 is so turned that the

regenerating fluid from the regeneration tank *g* flows through the filter *c* in a direction opposite to the direction of filtration. Here the liquid surrenders the salts required for the regeneration and then flows through the valve 4 and pipe *i* toward the channel. When the regeneration vessel *g*, the dimensions of which must, of course, be adapted to the work required of the chemical filter, has been emptied, the back-washing of the filters *b* and *c* is undertaken.

The purpose of this is, in the first place, to remove the possible excess of salts in the filter *c* and thus to maintain, at all events, the pure water which is afterwards taken out, free from these salts, which is of especial advantage for drinking water plants, and moreover to free the mechanical filter *b* which may consist of excelsior, gravel, etc., of slime by means of back-washing. To back-wash the valves 2 and 4 are closed, the valves 3 and 5 opened, (Fig. 3) so that from the back-wash container *h* the water passes through the pipe *f*, the two filter beds *c* and *b*, the valve 5 and the pipe *k* to the sewer.

By the arrangement of the flow-off cell *d* it is made possible to build into one apparatus two superposed filter bodies of entirely different character and yet effect, without any difficulty, the regeneration separately from the removal of slime.

In this way, one obtains, as compared with all heretofore known apparatuses serving a similar purpose, while using a small amount of chemicals for its operation, an apparatus of simple construction.

The manipulation of the valves can be performed by hand as well as automatically, by means of a float, for instance.

609 For increased production and to avoid too large a construction, the apparatus can be built closed and operated under pressure without any particular change in the arrangement of the various elements.

There are cases, in which a chemical filter body is not able to absorb all the salts in solution. These cases according to this invention, are taken care of in this way that further chemical filter bodies are built into the casing *a* of the apparatus, while filter bodies may be just as easily regenerated as the one filter provided in the above described simple filter. The figures 4 to 6, for instance, show an apparatus provided with two superposed filters formed by permutits.

b is again the mechanical filter, while *c* and c_1 represent the chemical filters. These are separated by a partition *m* built into the casing. However, they can be connected by a conduit *n* and a cock 6, provided therein. Between the filters *b* and c_1

and between the partition m and the filter c_2 a flow-off cell d_1 and d_2 respectively is built in. From these and the space above the filter b conduits k, i_1 and i_2 adapted to be closed by cocks 7, 8 and 9 lead toward the discharge pipe.

For the regeneration of each of the two filters c_1, c_2 a special conduit and for the cleaning of the three filters b, c_1, c_2 a common conduit is provided. Because of the arrangement of a conduit for the regeneration of each of the two chemical filters, the regenerating operation does not require more time in this double filter than in the simple filter.

Fig. 4 shows the position of the cocks during filtering operation.

The liquid to be purified flows through the conduit 1 and cock 10 toward the filter b is freed here from its mechanical impurities, passes through the flow-off cell d_1 and is subjected in the filter c_1, to a partial treatment. From here, the water flows through conduit n and the distributing pipe o toward the filter c_2, in which the treatment is now completed.

For the purpose of regeneration, the cocks are now turned into the position shown in Fig. 5. From the regeneration tank g, the solution now flows through the pipe f in a direction opposite to the direction of filtration toward the filter body c_1, regenerates the same and flows off again through the pipe i_1.

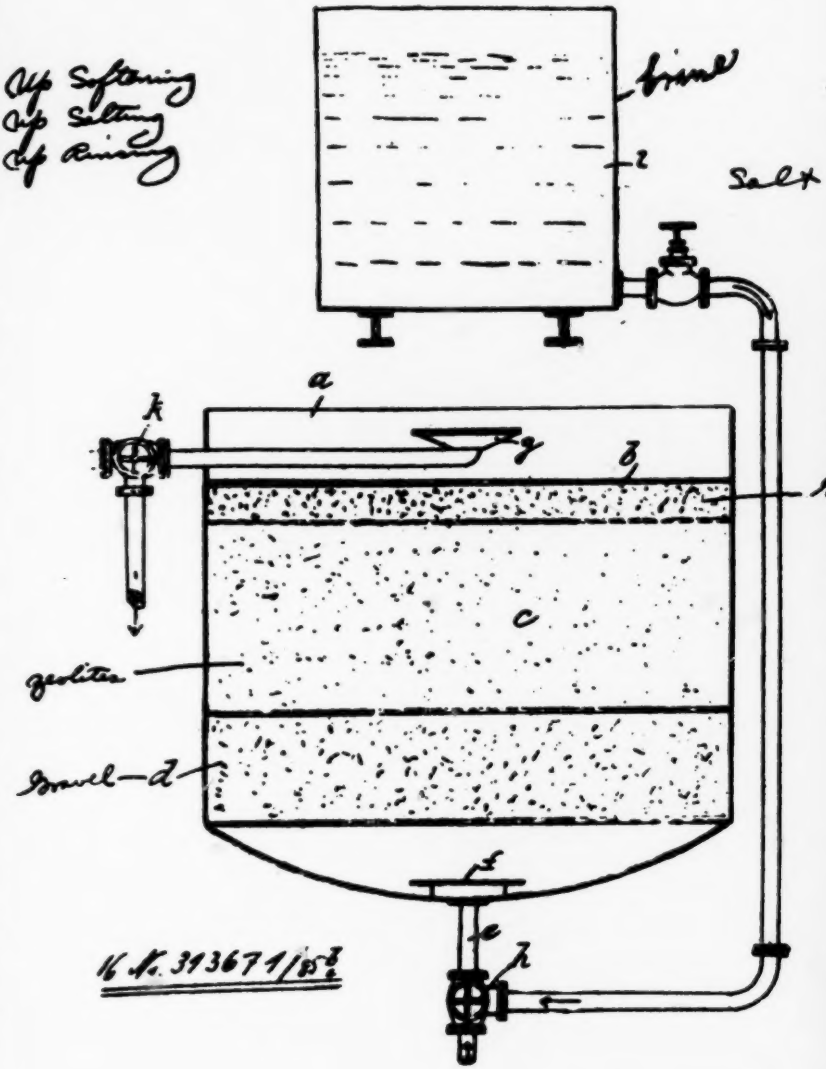
In the same way, from the tank g_2 the solution intended 610 for the second filter c_2 flows through cock 3 and pipe f_2, toward this filter body, regenerates the same and flows through pipe i_2 toward the discharge pipe. When the regeneration is completed, the general backwashing operation can start again, *i. e.* the various cocks are turned into the positions shown in Fig. 6.

The back-wash tank h is in this case provided with two short connection pipes, which are dimensioned according to the consumption of wash water in each stage.

Claim.

Filter apparatus consisting of several superposed filter layers arranged in a casing, separated from each other by spaces and provided with special inflow respectively outflow cells for each filter layer connected to common discharge and wash water conduits, characterized by this, that one (c) or several (c_1, c_2 ——) of the filter layers consist of permutits (arfificial zeolites) and are so connected by a pipe conduit branching off from the common wash water conduit for the

mechanical filter b and the chemical filter c_1, c_2—with the vessel containing the regenerating liquid for the permutit filter that the regenerating liquid can not enter the adjacent mechanical filter.


Up Softening
Up Salting
Up Rinsing
brine
2
Salt
a
h
g
b
m
c
zeolite
Gravel—d
e
f
h
U. S. 313671 1/85
hard water

582 DEFENDANT'S EXHIBIT NO. 31.

Agreed Translation, Defendants' Exhibit Gebrauchsmuster 313,671.

G. M. No. 313 671
R. 19 536 85b

Berlin, June 27th, 1907.
P. A. 218 048—27.6. 07.

Dr. L. Wenghoffer
Patent Attorney

To the Imperial Patent Office,
Department for Gebrauchsmuster

Berlin,

I herewith submit:
No. 1 Power of attorney.
No. 2 and 3 Specification in duplicate.
No. 4 and 5 Drawings,
and apply for the registration of a novelty which is described in these enclosures, in the name of the Firm J. D. Riedel Aktiengesellschaft, Berlin
Gerichtstrasse 12/18
Under the title:
"Filter for Removing the Lime from Boiler Feed Water consisting of a box with permutit (zeolith) filler enclosed between layers of gravel, and regenerating Device"
The Official fee of M. 15 has been paid to the Cashier of the Patent Office to-day.

Respectfully,

DR. L. WENGHOFFER.

Dr. L. Wenghoffer

P. A. 218 048—27. 6. 07.

Patent Attorney
"Filter for Removing the Lime from Boiler Feed Water Consisting of a Box with Permutit (Zeolith) Filled enclosed between Layers of Gravel, and Regenerating Device".

The subject of the application is a filter for removing lime from boiler feed water. The filter apparatus consists in principle of a box-like container in which is arranged a permutit
583 layer, (a layer of artificial zeolith), which is enclosed from both sides by gravel layers. The container is further equipped with a regenerating device for the zeolith material.

The subject of the application is shown in the drawings in a vertical section. *a* is a box-like container, the lower part of which is funnel shaped. The box contains three layers, the lowest layer of gravel *d* of about 30 ctm. thickness; then a zeolith filler *c* containing 750 liters of zeolith and above the latter again a layer of gravel *b* of 20 ctm thickness. The water to be softened enters at the bottom through pipe *e* into the container *a*, it is distributed by means of a baffle plate *f*, which is arranged immediately above the inlet; it passes through the gravel and zeolith layers and then leaves the filter completely freed from lime or magnesia; through the discharge pan *g* it is conveyed to the place where it is to be used, a boiler, tank or the like. If lime is again noticed in the boiler feed water the zeolith layers must again be regenerated and for this purpose the two-way valve *h* is so turned that from a container *i* a solution containing about 15% of solium chloride is passed through the filter at a speed of 200 mm. Also the salt solution flows off through the discharge pan *g* and is passed through the two-way valve *k* and through the front discharge pipe.

The gravel layers *b* and *d* have the purpose to prevent that the zeolith becomes slimy by mechanical impurities contained in the feed water. At the height of the lower gravel layer the container *a* is equipped with a manhole in order to remove the gravel when it gets dirty and to clean it.

Gravel and zeolith are resting on fine perforated screens which consist best of solid iron bodies.

The filter plant can be enlarged for softening larger quantities of water by enlarging the diameter of the filter while the thickness of the permutit layer of about 50 ctm. may be maintained.

Claim:

Filter for removing lime from boiler feed water consisting of a box with permutit (zeolith) layer enclosed between layers of gravel, and regenerating device.

DR. L. WENGHÖFFER.

Fig. 1.

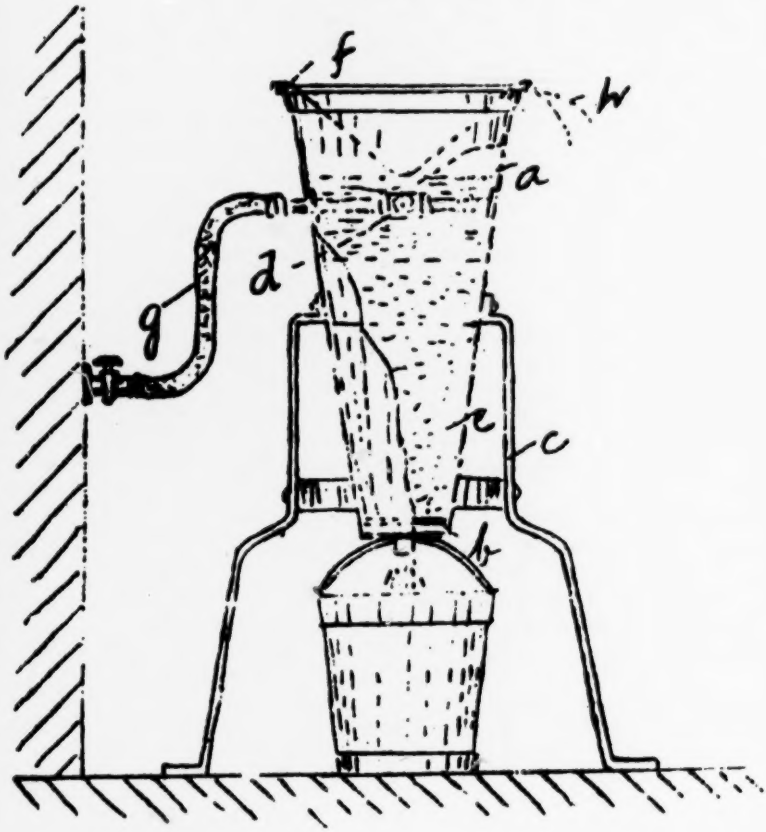


Fig 2

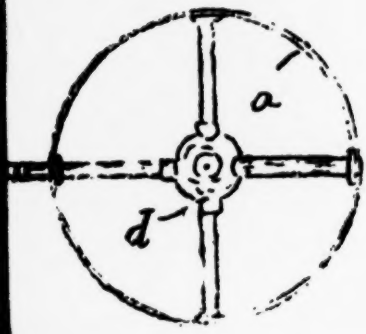


Fig. 3

N. 341572 1/2

576 DEFENDANT'S EXHIBIT NO. 29.

Translation, Defendants' Exhibit 246,
Gebrauchsmuster 341,512.

No. 341,512 Class 12 d.

August Neumann, Berlin W.

"Soft Water Filter with Cross-shaped Sprinkler, and Attachable Filtering Bag.

Filed: May 8, 1908
Registered: May 30, 1908
Published: June 15, 1908.

Claim.

Soft Water Filter for domestic purposes, laundries, restaurants, etc., characterized by the arrangement of a sprinkler which is suitably arranged below the level of the hard water and may have the shape of a cross or the like in order to reinforce the walls of the filter-case and, by a detachable filtering bag *f*, serving to receive the regenerative medium (for instance) a common salt solution.

Description

The subject matter of the present invention is a filter to soften water under use of natural zeolites, artificial zeolites or other substances having the property to absorb lime contained in and hardening the water. The new filter is therefore in particular adapted for domestic use, laundries, restaurants etc.

The accompanying drawing illustrates by way of example a form of construction and,

Fig. 1, is a lateral view,

Fig. 2 a perspective view of a special part of Fig. 1.

Fig. 3 a perspective view.

Letter *a* in Fig. 1 designates a tank, preferably constructed of zinc, in the lower part of which a strainer *b* has been inserted. Tank *a* is supported by frame *c*. In its upper part is positioned a cross-shaped sprinkler *d* (see figures 1 and 2), below the same a filtermass *e* consisting of zeolite or the like. *f* (figures 1 and 3) is a filter bag detachably arranged above sprinkler *d* on case *a*. *g* is a rubber hose or the like forming

the connecting link between the water main or any other source of water and sprinkler *d* of the filter. As may be seen from Fig. 2, this sprinkler not only serves the feeding and
577 distribution of the water to be filtered but, by reason of its shape it likewise strengthens the walls of case *a* and protects them against warping.

The operation of the device is as follows:

The water to be softening flows through hose *g* to case *a*, the inflow being preferably so controlled that sprinkler *d* lies below the level of the water. This secures a quiet flow and prevents unnecessary stirring-up of the zeolite layer. The water to be softened passes through layer *e*, strainer *b*, and runs in a completely softened state to the pail positioned below case *a*.

When the zeolites have lost their power to exchange bases and, in consequence, are no longer able to absorb lime, they are regenerated by being flushed with a common salt solution or the like.

To this end, the filter bag *f* is placed on the case in the manner shown in Fig. 1 and is there fastened by tightening the cord in its edge or in any other appropriate manner, whereupon the common salt solution is poured in the bag. It slowly passes through the zeolite layer and speedily regenerates the filter.

The light construction of the apparatus and the fact that the zeolite layer weighs only one kilogram, insure convenient transportation of the device which may therefore be attached to any pump.

836 Northern District of Illinois, } ss.
Eastern Division. }

I, Charles M. Bates, Clerk of the District Court of the United States, for the Northern District of Illinois, do hereby certify the above and foregoing to be a true and complete transcript of the proceedings had of record made in accordance with Praecipe filed in said cause; that the copies contained in said transcript are certified to be true and correct copies of the originals from which they purport to have been made without comparison with the originals, as per stipulation of counsel filed herein; and that the original records and files from which said copies purport to be made are and remain in my custody and control.

I hereby further certify that I have complied with the Praecipe relative to certifying up to the Court of Appeals certain physical exhibits named in said Praecipe.

In Testimony Whereof, I have hereunto set my hand and affixed the seal of said court, at my office in the City of Chicago, in said District, this 29 day of May, 1930.

CHARLES M. BATES
Clerk.

(Seal)

837 United States } ss.
of America, }

Citation filed May 27, 1930.

The President of the United States, To Graver Corporation. Greeting:

You are hereby cited and admonished to be and appear at a United States Circuit Court of Appeals, for the Seventh Circuit, to be holden at Chicago, within thirty days from the date hereof, pursuant to Petition and Order for Appeal, filed in the Clerk's Office of the District Court of the United States for the Northern District of Illinois, Eastern Division, wherein The Permutit Company, is plaintiff, and you are defendant, to show cause, if any there be, why the decree rendered against the said plaintiff as in the said Petition and Order for Appeal mentioned, should not be corrected and why speedy justice should not be done to the parties in that behalf.

Witness the Honorable Walter C. Lindley, judge of the

United States District Court of the United States this 22nd day of April, in the year of our Lord one thousand nine hundred and Thirty.

WALTER C. LINDLEY
Judge, United Stotes District Court.

* * (Caption) * * Citation. Filed May 27 1930 at .....o'clock .....m. Charles M. Bates Clerk. Dyrenforth Lee Chritton & Niles Attys for Plaintiff.

ipulation filed June 10, 1930.

IN THE DISTRICT COURT OF THE UNITED STATES,

For the Northern District of Illinois,

Eastern Division.

The Permutit Company,
Plaintiff,
vs.
Graver Corporation,
Defendant.
} In Equity, No. 7909.

STIPULATION.

It is stipulated between counsel for the respective parties that, in printing the record in the Court of Appeals, the following need not be printed:

1. The title of the case and all the pleadings (after the title in the bill of complaint) and exhibits.
2. The following exhibits, which we are identifying by the Praecipe number, as well as by a description of the exhibits themselves:

(a) Plaintiff's Exhibit 13 (Bulletin of Agricultural Station).

(b) Plaintiff's Exhibit 14 (Photograph of a piece of scale).

(c) Plaintiff's Exhibit 15 (a page from the publication "Power").

(d) Plaintiff's Exhibit 16 (Bulletin of Agricultural Station).

(e) Plaintiff's Exhibit 17 (Page from the publication "Canning Trade").

(f) Defendant's Exhibit 21 (Agreed English translation of German Patent Law). 542-548

(g) Defendant's Exhibit 22 (Agreed English translation of German Law on protection of Gebrauchmuster). 549-550

(h) Defendant's Exhibit 23 (Langner testimony in American Chain Company case), 551-560

(i) Defendant's Exhibit 28, all printed matter from Gebrauchsmuster No. 341,512, the drawing however to be reproduced and printed.

(j) Defendant's Exhibit 30, all printed matter from Gebrauchsmuster No. 313,671, the drawing however to be reproduced and printed.

(k) Defendant's Exhibit 32, all printed matter from Feldhoff article of September 7, 1907, the drawing however to be reproduced and printed. 584-587

(l) Defendant's Exhibit 34, all printed matter from Leister patent (Ger.) No. 211,064, of January 23, 1908, the drawing however to be reproduced and printed. 601-603

(m) Defendant's Exhibit 60 (Weiss Thesis), omitting from the printed record all German printed matter in this thesis, but reproducing in the printed record all drawings in the thesis. 667-678

(n) Defendant's Exhibit 65 (Gans file-wrapper and contents). 708-801

3. That all patents which are to be printed or reproduced in the printed record may be set up in type or plates made therefor, instead of using photostats, and that it will not be necessary to make, in the event of setting the patents up in type, line for line copies.

Dated at Chicago, Illinois, June 9, 1930.

GEORGE A. CHRITTON
Counsel for Appellant.

CHAS. L. BYRON
Counsel for Appellee.

(Endorsed:) 4390 The Permutit Co. vs. Graver Corporation. Stipulated as to printing Record. Filed June 10 1930 Edward M. Holloway Clerk.

UNITED STATES CIRCUIT COURT OF APPEALS

For the Seventh Circuit.

I, Edward M. Holloway, Clerk of the United States Circuit Court of Appeals for the Seventh Circuit, do hereby certify that the foregoing printed pages, numbered from 1 to 669, inclusive, contain a true copy of the Printed Record, printed under my supervision and filed on the third day of July, 1930, on which the following entitled cause was heard and determined:

The Permutit Company,
Appellant,

vs.

Graver Corporation,
Appellee,

No. 4390, October Term, 1930, as the same remains upon the files and records of the United States Circuit Court of Appeals for the Seventh Circuit.

In Testimony Whereof I hereunto subscribe my name and affix the seal of said United States Circuit Court of Appeals for the Seventh Circuit, at the City of Chicago, this 23rd day of December, A. D. 1930.

EDWARD M. HOLLOWAY,
(Seal) *Clerk of the United States Circuit Court of Appeals for the Seventh Circuit.*

At a regular term of the United States Circuit Court of Appeals for the Seventh Circuit begun and held in the United States Court Room in the City of Chicago in said Seventh Circuit on the first day of October, 1929, of the October Term in the year of our Lord one thousand nine hundred and twenty-nine, and of our Independence the one hundred and fifty-fourth. Placita.

And afterwards, to wit: On the fourth day of June, 1930, there was filed in the office of the Clerk of this Court the original Transcript of Proceedings in the District Court, certified to the Court of Appeals by the Clerk of the District Court as a physical exhibit, which said Original Transcript of Proceedings is not copied here.

And on the same day, to wit: On the fourth day of June, 1930, there was filed in the office of the Clerk of this Court an appearance of counsel for Appellant, which said appearance is in the words and figures following, to wit: Filed June 4, 1930.

UNITED STATES CIRCUIT COURT OF APPEALS

For the Seventh Circuit.

No. 4390. October Term, 1929.

The Permutit Company,
Appellant,

vs.

Graver Corporation,
Appellee.

The Clerk will enter my appearance as Counsel for the Appellant.

DRURY W. COOPER,
ALLAN C. BAKEWELL,
42 Broadway, New York City.
GEORGE A. CHRITTON,
140 So. Dearborn St.,
Chicago, Illinois.
DYRENFORTH, LEE, CHRITTON & WILES,
Attorneys for Appellant.

Endorsed: Filed June 4, 1930. Edward M. Holloway, Clerk.

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ed June 6, 1930.

And afterwards, to wit: On the sixth day of June, 1930, there was filed in the office of the Clerk of this Court an appearance of counsel for Appellees, which said appearance is in the words and figures following, to wit:

UNITED STATES CIRCUIT COURT OF APPEALS

For the Seventh Circuit.

No. 4390. October Term, 1929.

The Permutit Company,
Appellant,

vs.

Graver Corporation,
Appellee.

The Clerk will enter my appearance as Counsel for the Appellee.

GEO. L. WILKINSON,
CHAS. L. BYRON,
38 So. Dearborn St.,
Chicago, Ill.

Endorsed: Filed June 6, 1930. Edward M. Holloway, Clerk.

And afterwards, to wit: On the tenth day of June, 1930, there was filed in the office of the Clerk of this Court a Stipulation Re: Printing Record, which said Stipulation is not copied here as the same appears on pages 668 and 669 of the printed record in this cause certified herewith.

And afterwards, to wit: On the nineteenth day of June, 1930, there was filed in the office of the Clerk of this Court an appearance of counsel for Appellant, which said appearance is in the words and figures following, to wit: Filed June 1 1930.

UNITED STATES CIRCUIT COURT OF APPEALS

For the Seventh Circuit.

No. 4290. October Term, 1929.

The Permutit Company,
Appellant,

vs.

Graver Corporation,
Appellee.

The Clerk will enter my appearance as Counsel for the Appellant.

MITFORD C. MASSIE,
220 Broadway,
New York, N. Y.

Endorsed: Filed June 19, 1930. Edward M. Holloway, Clerk.

And afterwards, to wit: On the fifteenth day of July, 1930, there was filed in the office of the Clerk of this Court a Stipulation to extend time for filing briefs, etc., which said Stipulation is in the words and figures following, to wit:

Filed July 15, 1930.

IN THE UNITED STATES CIRCUIT COURT OF APPEALS,

For the Seventh Circuit.

The Permutit Company,
Appellant,
vs.
Graver Corporation,
Appellee.
No. 4390.

STIPULATION.

It is stipulated between counsel for the respective parties that the appellant shall have until August 11, 1930, to file its brief herein, the appellee until September 15, 1930, the appellant until September 30, 1930, to file its reply brief, and that the case may be set down for oral argument on Thursday, October 9, 1930, at 9:30 A. M.

Dated at Chicago, Illinois, July 15, 1930.

GEORGE A. CHRITTON,
Counsel for Appellant.
CHAS. L. BYRON,
Counsel for Appellee.

Approved:
GEORGE T. PAGE,
Judge.
July 15/30.

Endorsed: Filed Jul. 15, 1930. Edward M. Holloway, Clerk.

And on the same day, to wit: On the fifteenth day of July, 1930, the following further proceedings were had and entered of record, to wit: Entered July 15, 1930.

Tuesday, July 15, 1930.

Court met pursuant to adjournment.

Present:

Hon. George T. Page, Circuit Judge.
Edward M. Holloway, Clerk.
Henry C. W. Laubenheimer, Marshal.

The Permutit Company
4390 *vs.*
Graver Corporation

Appeal from the District Court of the United States for the Northern District of Illinois, Eastern Division.

Pursuant to stipulation of counsel, it is now here ordered that the time for filing brief for appellant in this cause be, and the same is hereby extended to August 11, 1930; and the time for filing brief for appellee is hereby extended to September 15, 1930, and the time for filing reply brief for appellant is hereby extended to September 30, 1930.

It is further ordered that this cause be, and the same is hereby set down for hearing on Thursday, October 9, 1930, at nine-thirty o'clock, A. M.

At a regular term of the United States Circuit Court of Appeals for the Seventh Circuit begun and held in the United States Court Room in the City of Chicago in said Seventh Circuit on the seventh day of October, 1930, of the October Term in the year of our Lord one thousand nine hundred and thirty, and of our Independence the one hundred and fifty-fifth.

Entered Oct. 9, 1930.

And afterwards, to wit: On the ninth day of October, 1930, the following further proceedings were had and entered of record, to wit:

Thursday, October 9, 1930.

Court met pursuant to adjournment and was opened by proclamation of crier.

Present:

Hon. Samuel Alschuler, Circuit Judge, presiding.
Hon. Evan A. Evans, Circuit Judge.
Hon. William M. Sparks, Circuit Judge.
Hon. George T. Page, Circuit Judge.
Edward M. Holloway, Clerk.
Henry C. W. Laubenheimer, Marshal.

Before:

Hon. Evan A. Evans, Circuit Judge.
Hon. William M. Sparks, Circuit Judge.
Hon. George T. Page, Circuit Judge.

The Permutit Company
4390 *vs.*
Graver Corporation

} Appeal from the District Court of the United States for the Northern District of Illinois, Eastern Division.

Now this day come the parties by their counsel and this cause now comes on to be heard on the printed record and briefs of counsel and on oral arguments by Mr. Drury W. Cooper, counsel for appellant, and by Mr. Charles L. Byron, counsel for appellee, and the Court having heard the same, takes this matter under advisement.

And afterwards, to wit: On the twentieth day of October, 1930, there was filed in the office of the Clerk of this Court, the Opinion of the Court, which said Opinion is in the words and figures following, to wit:

IN THE UNITED STATES CIRCUIT COURT OF APPEALS

Filed Oct. 20, 1930.

For the Seventh Circuit.

No. 4390. October Term, 1930, October Session, 1930.

The Permutit Company, *Appellant,*
vs.
Graver Corporation, *Appellee.*

Appeal from the District Court of the United States for the Northern District of Illinois, Eastern Division.

October 20, 1930.

Before EVANS, SPARKS and PAGE, *Circuit Judges.*

EVANS, *C. J.:* This appeal presents for determination the validity, and appellee's infringement, of Claims 1 and 5 of the Gans patent No. 1,195,923 covering an apparatus "for Softening of Water". The District Court found both claims invalid and dismissed the suit.

The Gans patent has been before the Courts on numerous occasions. The two claims in question (1 and 5) have been upheld by two Circuit Courts of Appeal (279 Fed. 713) (13 Fed. (2d) 454). They have also been sustained by three District Courts, but only two opinions have been reported. (292 Fed. 239) (274 Fed. 937). The same claims have been held invalid by two District Courts, the decision of Judge Tuttle being reversed in 13 Fed. (2d) 454. In the instant suit the District Court, in a well reasoned opinion, expressed its unwillingness to follow the above cited decisions because convinced that both claims were clearly void.

The invention thus describes his invention:

> "This invention relates to an apparatus for softening water in the use of zeolites or hydrated alumino-silicates.
>
> "It is known that zeolites or hydrated alumino-silicates have the property of softening hard water and the present invention has for its object an apparatus in which

the zeolites or alumino-silicates can be used in a filter and be regenerated therein so as to be capable of continuous use for the softening of water.

"The zeolites or hydrated alumino-silicates that occur in nature are ill adapted, without special treatment for the purpose, inasmuch as their capacity for the exchange of their base, upon which their property of softening hard water depends, is relatively small, while they have little or no capacity for regeneration or reconversion to their original condition, whereby they can be continuously used.

"Furthermore zeolites or hydrated alumino-silicates for use in softening hard water by mere filtration of the hard water through them must not only possess a high capacity for exchange of their base and a high capacity for regeneration or re-conversion to their original condition, but they must be hard and large grained, and adapted by their physical qualities for use as filtering media."

In speaking of the patent, the Court in 13 Fed. (2d) 454, say:

"Without repeating the details found in these opinions, it is sufficient now to say that it had long been known with regard to zeolites, a somewhat rare natural mineral combination, that they had the faculty of taking up the lime from hard water, thereby making it soft. This having been accomplished, and the zeolites then being charged with this lime, it in turn could be removed by putting them in salt water, after which they would again be ready to perform the softening operation. It seems that this process continued practically only a laboratory operation until Dr. Gans invented an artificial zeolite, which could be produced in large quantities at a practicable cost. * * *

"The process has gone into enormous use in this country, and rarely is there a case where a new art and industry are founded solely upon, and grow entirely from, a patent, so clearly as in this case."

The two claims in issue read:

"1. A water softening apparatus comprising a casing, a filter bed consisting of a layer of sand or quartz and a layer of zeolites or hydrated alumino-silicates disposed on the layer of sand or quartz, means for permitting the passage of water through the casing, means for cutting

off the supply of water on the exhaustion of the zeolites, and means for passing through the casing a solution of a salt capable of regenerating the zeolites."

"5. Water softening apparatus comprising a casing, a filter bed consisting of a layer of zeolites or aluminosilicates, supporting means for said layer, means for permitting the passage of water through the casing, means for cutting off the supply of water on the exhaustion of the zeolites, means for supplying and passing into the casing a solution of a salt capable of regenerating zeolites and means connected *to the lowest point of the casing* for removing the salt solution so introduced."

About four years after the patent was issued, a disclaimer was filed which reads as follods:

"The Permutit Company, * * *, represents that it is the owner of the entire right, title and interest in and to patent No. 1,195,923, dated August 22, 1916, this patent having been granted on an application filed by Robert Gans, of Berlin, Germany, to J. D. Riedel Aktiengesellschaft, of Berlin, Germany, as the assignee of Robert Gans, and having been duly assigned to your petitioner, * * *; that it has reason to believe that, through inadvertence, accident or mistake, the specification and first claim of said patent are too broad including that which said Robert Gans was not entitled to claim in said patent.

"Your petitioner, therefore, does hereby disclaim from the scope of claim 1 of patent 1,195,923, any water softening apparatus including a layer of zeolites or hydrated alumino-silicates disposed on a layer of sand or quartz in which the water to be softened is so introduced into the casing that it passes upwardly through said layer of zeolites. * * *"

It will be observed that the invention deals not with the use of zeolites as such nor with the regeneration of zeolites but rather with an apparatus which makes use of zeolites as a water softener and which also permits of the injection and removal of salt into the casing to regenerate the zeolites which have lost their potency through use. The discovery of zeolites and their use as water softeners long antedate the application for the patent in suit. Gans was a pioneer in the field of chemistry dealing with water softeners. Several years before applying for the patent in suit, he made application for a patent on artificial zeolites and a process of pro-

ducing the same. In the specifications for this patent he recognized the then existing state of the art respecting the use of zeolites when he said:

> "The purification or the softening of water may be effected in a simple manner by filtering the water through a layer of zeolites or alumino-silicate containing sodium.
>
> "On the saturation of the zeolites with the bases of the salts contained in the hard water, the zeolites may be reconverted or renegerated by filtering through them a solution of a sodium salt, by which a sodium alumino-silicate is again produced."

Thus it will be seen that we are confronted by a combination product patent only. Utility of zeolites or the effect of salt on zeolites is not involved.

The two claims as originally allowed differed only in one respect, in the appearaance in Claim 5 of the last named element, to-wit, "means connected to the lowest point of the casing for removing the salt solution so introduced." After the disclaimer was filed the differences between the two claims increased as the disclaimer only applied to Claim 1.

Appellee argues that the disclaimer should also apply to Claim 5. But we are unwilling to accept this contention. For while it might be said that the same reason existed for limiting his apparatus to such structures as introduced the water into the casing from the top, the fact remains that patentee specifically limited his disclaimer to Claim 1. A disclaimer is the act of the patentee. The extent of such disclaimer must be determined by the words used. Here the disclaimer specifically limited its application to Claim 1. We are, therefore, not at liberty to extend it beyond the clear and binding limitations which the patentee described.

In view of our conclusion respecting the validity of the two claims, it is not necessary to describe the various forms of apparatus which appellee made and sold, some of which quite obviously did not infringe either Claim 1 or Claim 5 while others apparently did infringe one claim or the other.

Claim 1. Appellee contends, first, that the structure described by Gans, in claim 1, for the use of zeolites as a water softener and for regenerating zeolites did not, regardless of the prior art, constitute invention. It also argues, as an alternative, that the validity of this claim must be denied in view of the prior art which showed similar structures,—namely, a casing at the bottom of which was an unconfined body of zeolites through which the water passed either up-

wardly or downwardly, and means for the introduction of salt into the casing that the zeolites might be regenerated.

Appellant on the other hand denies the existence of an anticipating prior art or a prior art sufficient to teach the skilled mechanics how to make the apparatus defined and described in the patent. It asserts novelty over the prior art in two respects (a) an unconfined bed of zeolites, and (b) means for causing the water to pass downward through the zeolites.

Appellant's counsel describes the novelty of the Gans invention, thus,—

> "The apparatus of the patent is relatively simple. It comprises a cylindrical container near the bottom of which is a horizontal perforated plate on which is a layer of gravel. This gravel supports a bed of zeolites. At a distance above the zeolite bed, and *so as to have a free space above it,* into which the bed may rise or boil up, is a plate which carries filtering material. * * *
>
> "There are two features of construction of a zeolite softener which are of the greatest importance in carrying the invention of this patent into effect. These features are:
>
> "(1) The zeolite bed must be free and unconfined at its top so that the zeolites can lift, loosen, or boil up to prevent accumulation of dirst or slime in the bed; and to permit a rearrangement of the grains to destroy preferred channels and construct a top layer of fine grains in the production of a uniform resistance across the entire top area of the bed.
>
> "(2) After regeneration the spent salt solution must be completely removed from the casing to prevent contamination and rehardening of the water on the next softening run."

Respecting the novel feature (b) appellant relies upon the holding of the Court in 13 Fed. (2d) 456, where it was said:

> "Under the language of the claim as issued, the flow of the water through the zeolites might have been either upward or downward. Early in the litigation a German publication was produced which was claimed to disclose the same process, but which showed the water passing upwardly. The drawings and description in the patent in suit showed that the water flowed downwardly, and Gans became convinced, even if he did not at first appreciate, that the downward flow, as distinguished from the upward, was practically essential to a commercially successful process. * * *

"Nor does it follow that in this particular environment there is no patentable distinction between the down flow and the up flow. The former works satisfactorily, and it seems probable, if not certain, that the latter would not. The reasons why one will and the other will not sohw that this difference is one of those which are not so simple as they seem."

In the instant suit the advantages or disadvantages of an apparatus calling for a down flow of water through the zeolites were sharply contested. The District Judge found, contrary to the observations of the Court in the last cited case, "the evidence in the instant case is conclusive to the effect that upward flow softeners are in fact of greater utility and efficiency than down flow softeners."

An examination of the evidence not only sustains the finding of the District Court but persuasively supports it. In view of the object to be accomplished, it would seem difficult, if not impossible, to say there was either merit or novelty in providing means which called for the down flow rather than the up flow of water through the bed of zeolites. The finding of the District Court, however, conclusively eliminates this asserted novelty (b) which resides in an apparatus which provides for the *down flow* of the water through the zeolites.

Confronted with a problem of providing means for the introduction of water into a casing at the bottom of which was a layer of gravel upon which rested a layer of zeolites, and through which the water was to pass, the mechanics had the choice of running the water upward or downward. As no new results attended the flowing of the water either way, it merely called for the exercise of discretion on the part of the mechanic to place the opening either at the top or at the bottom of the casing.

Much stress is placed on the novel feature (a), the unconfinable character of the bed of zeolites. The advantages of an *unconfined* bed of zeolites are now stoutly proclaimed. Because open at the top it is claimed that the zeolites receive the water and the salt more freely and evently and both the water softening and the zeolite regeneration are more complete. For the purpose of the argument only it may be ceded that an unconfined zeolite bed had merit as well as novelty. But of what significance is this fact to the patentee who did not include in his specifications or in his claims a zeolite bed so limited?

We have looked in vain, in the claims and in the specifica-

tions of the Gans patent, for any language which mentions a zeolite bed which is free and unconfined. If the novelty of this invention, as it is now asserted, resides in the free and unconfined bed of zeolites, it is more than passing strange that the inventor should make no reference, either in specifications or in claims, to that which marked his advance over the prior art. Courts are not permitted to read into a claim a limitation of one of the elements which the patentee has not seen fit to impose. For what is not claimed by the patentee belongs to the public.

If there was a suggestion in either specifications or claims that permitted of an inference that a limitation of this element was intended, we might find some basis for supporting the construction for which appellant contends. But there seems to have been a studious avoidance of words of limitation,—a designed effort to make the elements as broad as possible which is entirely inconsistent with the now asserted limitations to this element without which validity cannot be recognized.

Moreover, there is another reason why this claim 1 is invalid.

If we read into this claim this limitation, and assume that the Gans patent called for an *unconfined* bed of zeolites, a study of the prior art leads us to the same conclusion. In short, there was no novelty in the unconfinable character of the bed of zeolites.

This prior art, a study of which is necessary to ascertain whether novelty resided in the uynconfinable character of the zeolites, is supplied largely by German chemists. Foremost among them is Gans. Much of the prior publications came from his pen. Some appear in his patents. Other articles are written by his associate.

Some dispute has arisen over the translation of a Gans article written in the German language. In a study of the various translations and in the differences that arise over them it is significant that Gans himself did not testify or explain or attempt to explain what appellee asserts was fatal to his right to a patent in the United States. He also failed to explain why he did not apply for a patent in Germany on the apparatus here under consideration. Gans was evidently an inventor who knew the value of patents and the record shows he secured several of them in the United States. His failure to secure one in Germany suggests, at least, that he was perhaps embarrassed by this prior art.

Gans caused on article to be published April 15, 1909 on the subject "On the Technic of Water Purification." Quotations therefrom are here made:

> "The process, which is in question for this purpose, is in its most simple form a pure exchange process by which the calcium and magnesium of the water are taken up by the zeolite and the sodium is given off to the water. * * *
>
> "The regeneration is performed by washing off the zeolites, which have been saturated with calcium or magnesium, with a common salt solution, by which means a sodium zeolite is again produced which is again able to soften new quantities of water. * * *
>
> "There are already several filters of this sort in use, some to prepare soft water for boiler feed purposes and others for laundries. The filter plants mentioned are remarkable through the simplicity of their arrangement. * * *
>
> "The apparatus consists of an iron or wooden filter, the height of the permutit bed is determined by the hardness of the specific water and the rapidity of filtration. The useful effect is greater the more slowly the water flows through the permutit filter and the finer the grain thereof.
>
> "The permutit bed lies upon fine sand, which becomes coarser at the bottom. *At the top it is best closed off by a sand filter placed about one-third to one-half meter above the surface of the permutit layer.* The sand filter under many conditions can be replaced by a limestone filter, for instance, when treating water containing iron and acids. This arrangement of the upper sand or limestone filter will also prevent that by back-washings, the specifically lighter permutits are not mechanically washed away. * * *
>
> "* * * Various filters of this kind are already in use, partly for the production of soft water for boiler supply purposes, partly *for laundries.*
>
> "The filter plants in question are notable for the simplicity of their arrangement.
>
> "The softening is complete even in the case of cold water."

There would be little question of the complete anticipation of the Gans patent by this Gans article were it not for the

fact that appellant challenges the correctness of that part of the translation (5th par.) which is italicized.

There are several reasons aside from the testimony of the qualified translator which support the District Court's finding respecting the correctness of the above translation. We need not elaborate them. The District Court discussed them and concluded that they were most persuasive, particularly in the absence of any explanation by Gans.

There were other publications which evidenced rather clearly the state of the prior art. The German patent to Hans Leister No. 211,064 contained drawings wherein the bed of zeolites was unconfined. The Technische Rundschau article of January 27, 1909 was on the subject of water treatment with permutite. Permutite is another name for zeolite. Witnesses on the trial could not agree as to whether the article showed the zeolites to be in a locked bed or unconfined. The Feldhoff article of September 7, 1907 dealt extensively with the use of the Gans artificial zeolites for softening water and also disclosed an apparatus for the use of such zeolites. The following is quoted therefrom:

> "The water to be purified is led in from below, passes through a layer of gravel, provided for the protection of the permutites from mechanical impurities, forces itself through the permutite layer and leaves the filter fully de-limed by the outlet funnel *d*. When the filter is exhausted one passes a hot fifteen percent solution of sodium chloride through it and the proportion of about one-half kilogram salt to every cubic meter of the water filtered, and moreover via the same path as the water, by turning the two-way valve. In circulating the salt solution—the step of regeneration,—a lower circulation speed is chosen about one-fifth to one-sixth of the original rate of flow. Thereafter follows washing out with a strong stream of water until all the salt has been removed, when the filter is again ready for use. Here I have a 'regeneration.' "

The article also stated "that the water to be purified is led in from below, passing through the layer of gravel, then through the layer of permutite and leaves the filter fully delimed at outlet funnel D at the top."

It was this article which caused appellant to file its disclaimer. Other prior art citations were the Bommarius patents Nos. 519,565 and 632,091, each covering a "filter" and

each describing an apparatus for filtering water for drinking and other purposes. While neither contemplated the use of zeolites both covered apparatuses for use where water passed through a filtering bed, obviously a kindred art.

Defendant also offered in evidence two Gebrauchsmusters Nos. 341,512 and 313,671. Both of these Gebrauchsmusters we have excluded in reaching our conclusion. They were at best merely cumulative proof of a prior art and added nothing to the facts established by the other evidence. The other proof left us in no uncertainty.

We were likewise not satisfied that they came within the provisions of Section 31, Title 35, U. S. C. A. Convinced as we are that neither Gebrauchsmuster covered the Gans apparatus described in the patent in suit it follows that only the printed publication in the foreign country would be a bar to the Gans application in the United States. As the printed publication is restricted to the claims of the Gebrauchsmuster, it seemed extremely doubtful whether Gans' right to a patent in the United States could be barred by the disclosures in the specifications of the Gebrauchsmuster.

The weight of authority seems to exclude the use of the entire Gebrauchsmuster as anticipation. But the courts are divided in the question. *Permutit Co.* v. *Wadham,* 13 F. (2d) 454; *American Chain Co., Inc.* v. *Bethlehem Bumper Corp.,* 25 F. (2d) 759; *Commercial Acetylene Co.* v. *Acme Acetylene Co.,* 192 F. 321; *Permutit* v. *Paige & Jones Chemical Co., Inc.,* 22 F. (2d) 916; *Safety Gas Lighter Co.* v. *Fischer Bros. & Corwin,* 236 F. 955; *Steiner* v. *Schwarz,* 148 F. 868, 870; *Fireball Gas Co.* v. *Commercial Acetylene Co.,* 239 U. S. 156; *Leeds & Catlin Co.* v. *Victor Co.,* 213 U. S. 301, 319; *General Electric Co.* v. *Alexander,* 280 F. 852.

We have eliminated the two Gebrauchsmusters from our consideration of the case.

The sum total of all this prior art citation leaves it tolerably clear (a) that it was old and well recognized to use zeolites for softening water, (b) to regenerate zeolites with salt, and (c) that the usual apparatus for accomplishing such purpose was in general similar to the Gans apparatus which in turn was like water filtering apparatuses widely used.

This apparatus consisted almost of necessity of a container, usually a steel casing, into which the water entered and out of which it passed. The location of the entry and the exit holes was optional with the mechanic and depended on whether he desired the water to flow downward or upward.

Into this case the filtering material was placed, usually resting on a bed of gravel. Over the filtering material another bed of gravel was sometimes though not always placed, to prevent the filtering material from washing away. This upper bed of gravel either rested upon or was placed somewhat above the bed of filtering material. Both ways are suggested and both ways were used.

In addition means had to be provided for permitting the regenerating material to pass in and out of the casing and through the filtering material. Inasmuch as there was no advantage in introducing the salt below or above the zeolites the mechanic or plumber naturally placed the exit hole at or near the bottom of the casing.

Claim 5. The validity of Claim 5 can only be sustained (in view of our holding Claim 1 invalid) on the theory that the last named element "means connected to the lowest point of the casing for removing the salt solution" introduced a novel element which evidenced something more than the skill of a mechanic. If there be novelty in this element it is traceable solely to the location of the means at the lowest point of the casing. To provide the means for an outlet at the bottom of the casing, (to secure a perfect drain), can, we think, by no stretch of the imagination, be described as invention. It is hardly conceivable that one (a mechanic or an unskilled artisan) constructing an apparatus of the kind here under consideration would locate the opening to drain off the substance (liquid or solid), temporarily inserted, at any place other than at the bottom.

Moreover, the prior art here, too, stands between Gans and a valid patent. The Technische Rundschau contains a drawing of an apparatus for water softening through the use of zeolites and for regenerating the zeolites, which drawing located the means for removing the solution at the lowest point of the casing. One of the Bommarius filters had its outlet at the extreme bottom.

Finally it might be added that appellee's structures have their openings near the bottom but not at the lowest point of the casing and therefore do not infringe Claim 5. This is not so as to certain discarded structures, but as to its presently used structures, infringement of Claim 5 is not shown.

Counsel for appellant persuasively and properly argue that the presumption which arose from the grant of this patent has been greatly strengthened by the holdings of several courts. The force of this argument cannot be minimized.

The respect we entertain for these courts need hardly be stated. But the litigants have a right to the independent judgment of this court. The responsibility resting on us cannot be delegated. Nor can it be avoided. Nor can we ignore the opinions of other courts that have filed carefully prepared opinions wherein different conclusions have been reached. Moreover, we are satisfied, that the record in the instant case is somewhat different from the records presented on the other appeals.

Extensive use has also been stressed by counsel as a reason for upholding the patent. That there has been an extensive use of zeolites for water softening purposes must be admitted. Such use strongly evidenced outstanding merit in this mineral compound for water softening purposes. We are not, however, impressed with the argument that the extensive use is attributable to the apparatus for holding and regenerating the zeolites. The art was advanced by the discovery of the product,—zeolite in natural and artificial form,—and in the discovery of the water softening qualities of this product, supplemented by the further discovery that such article could be regenerated readily and cheaply. Gans obtained a patent in this country on zeolites and the process for making them. If this patent were assailed and doubt existed as to its validity, the extensive use relied on, would strongly support the patent. But we cannot ascribe this extensive use to both the commodity and to the apparatus for its use, when convinced that its actuating cause is to be found in the article only.

The decree is affirmed.

Endorsed: Filed Oct. 20, 1930. Edward M. Holloway, Clerk.

Entered Oct. 20, 1930.

And on the same day, to wit: On the twentieth day of October, 1930, the following further proceedings were had and entered of record, to wit:

Monday, October 20, 1930.

Court met pursuant to adjournment and was opened by proclamation of crier.

Present:

Hon. Samuel Alschuler, Circuit Judge, presiding.
Hon. Evan A. Evans, Circuit Judge.
Hon. William M. Sparks, Circuit Judge.
Hon. George T. Page, Circuit Judge.
Hon. Albert B. Anderson, Circuit Judge.
Edward M. Holloway, Clerk.
Henry C. W. Laubenheimer, Marshal.

Before:

Hon. Evans A. Evans, Circuit Judge.
Hon. William M. Sparks, Circuit Judge.
Hon. George T. Page, Circuit Judge.

The Permutit Company
4390 *vs.*
Graver Corporation

Appeal from the District Court of the United States for the Northern District of Illinois, Eastern Division.

This cause came on to be heard on the transcript of the record from the District Court of the United States for the Northern District of Illinois, Eastern Division, and was argued by counsel.

On consideration whereof, it is now here ordered, adjudged and decreed by this Court that the decree of the said District Court in this cause be, and the same is hereby affirmed with costs.

Filed Oct. 30, 1930.

And afterwards, to wit: On the thirtieth day of October, 1930, there was filed in the office of the Clerk of this Court a Stipulation to Stay Mandate, which said Stipulation to Stay Mandate is in the words and figures following, to wit:

IN THE UNITED STATES CIRCUIT COURT OF APPEALS,

For the Seventh Circuit.

The Permutit Company,
Appellant,
vs.
Graver Corporation,
Appellee.
} No. 4380.

It is stipulated between counsel for the respective parties that the sending down of the mandate herein by the Clerk of this Court may be stayed, until the further order of the Court, to permit the filing by the appellant of a petition for certiorari in the United States Supreme Court.

Dated at Chicago, Illinois, October 30, 1930.

DYRENFORTH, LEE, CHRITTON & WILES
Counsel for Appellant.

WILKINSON, HUXLEY, BYRON & KNIGHT,
Counsel for Appellee.

It Is Hereby Ordered Accordingly.

EVAN A. EVANS,
Judge.

Endorsed: Filed Oct. 30, 1930. Edward M. Holloway, Clerk.

And on the same day, to wit: On the thirtieth day of October, 1930, the following further proceedings were had and entered of record, to wit: Entered Oct. 30, 1930.

Thursday, October 30, 1930.

Court met pursuant to adjournment and was opened by proclamation of crier.

Present:

Hon. Samuel Alschuler, Circuit Judge, presiding.
Hon. Evan A. Evans, Circuit Judge.
Hon. William M. Sparks, Circuit Judge.
Hon. George T. Page, Circuit Judge.
Hon. Albert B. Anderson, Circuit Judge.
Hon. Louis FitzHenry, District Judge.
Edward M. Holloway, Clerk.
Henry C. W. Laubenheimer, Marshal.

Before:

Hon. Evans A. Evans, Circuit Judge.

The Permutit Company
4390 *vs.*
Graver Corporation

Appeal from the District Court of the United States for the Northern District of Illinois, Eastern Division.

Pursuant to stipulation of counsel, it is now here ordered that the mandate in this cause be, and the same is hereby stayed until the further order of this Court.

UNITED STATES CIRCUIT COURT OF APPEALS

For the Seventh Circuit.

I. Edward M. Holloway, Clerk of the United States Circuit Court of Appeals for the Seventh Circuit, do hereby certify that the foregoing printed pages, numbered from 673 to 693, inclusive, contain a true copy of the proceedings had and papers filed (except the briefs of counsel) in the case of The Permutit Company appellant vs. Graver Corporation, Appellee No. 4390, October Term, 1930, as the same remains upon the files and records of the United States Circuit Court of Appeals for the Seventh Circuit.

In Testimony Whereof I hereunto subscribe my name and affix the seal of said United States Circuit Court of Appeals for the Seventh Circuit, at the City of Chicago, this 23rd day of December, A. D. 1930.

EDWARD M. HOLLOWAY

(Seal) *Clerk of the United States Circuit Court of Appeals for the Seventh Circuit.*

SUPREME COURT OF THE UNITED STATES

ORDER ALLOWING CERTIORARI—Filed March 2, 1931.

The petition herein for a writ of certiorari to the United States Circuit Court of Appeals for the Seventh Circuit is granted. And it is further ordered that the duly certified copy of the transcript of the proceedings below which accompanied the petition shall be treated as though filed in response to such writ.